Essentials of Domestic Hygiene

Clare Goslett.

Lucy E. Wright.
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ESSENTIALS OF DOMESTIC HYGIENE

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ESSENTIALS OF
DOMESTIC HYGIENE

OR

Dangers and Safeguards of Indoor Life

BY

CLARE GOSLETT

MEMBER OF THE SANITARY INSTITUTE (LONDON), AND OF THE SOCIÉTÉ FRANÇAISE D'HYGIÈNE; LECTURER ON PHYSIOLOGY AND HYGIENE TO THE QUEEN'S NURSES, ST. GABRIEL'S, ROYAL HOLLOWAY, AND CHELTENHAM LADIES' COLLEGES; SUSSEX COUNTY HOSPITAL, ETC., ETC.

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Dedicated to

THE QUEEN'S NURSES,

IN LOVING APPRECIATION OF THEIR BEAUTIFUL WORK

"'Tis worth a thousand years of strife,
'Tis worth a good man's best of life,
If he can lessen but by one
The countless ills beneath the sun.'

PREFACE TO THE SECOND EDITION

Since the first Edition of this book was published a special impetus has been given to the study and teaching of Hygiene by the Report of the Parliamentary Committee on Physical Deterioration. All who have read this Blue Book must feel that a fresh burden of responsibility is laid upon them by the findings and recommendations therein contained. The evidence of witnesses and the conclusions of the Committee as to the causes of physical inefficiency and child mortality prove more forcibly than ever that most of these causes are removable, because most of them are to be found in the ignorance of the people. Again and again it is urged that all should strive both by example and teaching to create better family traditions in regard to the management and habits of domestic life. We are besought to make use of every existing agency for the teaching of mothers and girls, and for the dispelling of the prejudices and superstitions which still spoil multitudes of lives. Everyone can do something to help in this beneficent work. Everyone must want to lend a hand in this time of dire need.

The deaths of hundreds of little children daily under one year old even in this home-loving England is a ghastly blot on our civilization. Worse still is the contemplation of the wounded in the battle—the large numbers who survive, maimed, wrecked, handicapped

by physical and mental infirmities, through the action of the very same influences that had killed the rest. And the causes are so simple, so remediable in many cases, if only people knew. The incessant drinking of strong stewed tea, the unsuitable food, irregularity of feeding, stuffy darkened rooms, 'babies' comforters,' the late nights and shortened hours of sleep—such are some of the evils mentioned by the Commission as responsible for physical inefficiency and child mortality. They are relics of past beliefs and old traditions, to which people cling because their parents and grand-parents did such things before them. All that is wanted in many cases is better teaching, respectful, kindly teaching, hints dropped whenever opportunity offers, constant patient reminders of the better knowledge that has come. Surely we must feel more anxious than ever to acquaint ourselves and teach others. The opportunities of the teacher in school days are vast and far reaching, but greater still are the chances of the District Nurse. It is not only the children who must be taught in order that the next generation may be wiser and healthier. We want to reach the mothers of the present time, not only for their own sakes, and because that through them the lives of infants may be saved, but because it is home influence and example that tells in the long-run.

However carefully the teaching of Hygiene may be given at school, children will grow up to do in their homes and for their offspring what they saw their mothers do.

It is in the homes of the poor and uninstructed that the nurses can help so wonderfully by teaching as well as by example.

Therefore the claims of Hygiene have a greater demand than ever on their attention, and I venture most earnestly to commend these 'Essentials' to their careful study and remembrance.

KENILWORTH HOUSE, EALING, W.

February 2, 1905.

PREFACE

My apology for venturing to add one word to the many so ably written on the subject of Hygiene is that I have tried to confine myself to the actual essentials of one particular branch of the subject, for the sake of those who only want these essentials.

Hygiene has become so vast and comprehensive in its domain—it has drawn into its service so much of other sciences; it includes the consideration of so many abstruse and contested questions—that regular text-books are bound to include a great deal which is not really wanted by the majority of people, and much that the average student of Hygiene has not time to consider. And yet it is becoming more and more generally acknowledged by all who have thought about the matter that *everyone* should know something of Hygiene so far as it concerns home and person.

To the housekeeper such knowledge means the acquirement of the art of safe living amidst unavoidable dangers, and power to prevent many of life's greatest ills. To the district nurse, or to the philanthropic worker who seeks to ameliorate the sufferings and physical troubles of the poor, a knowledge of domestic and personal Hygiene

signifies ability to seize thousands of opportunities for doing good, which must otherwise pass by unrecognised and unheeded. But if time presses, and the opportunities for study are few, it is often very difficult to know how to choose, from a large mass of information, those points which are of primary consequence, and essential to the purposes of daily life.

Hence I venture to hope that by keeping to those parts of the great subject, and those principles and facts which are needed and should be understood by all, I may make the study of Domestic Hygiene easier and pleasanter for those who have not time or experience wherewith to search out actual essentials from the larger and more comprehensive text-books.

KENILWORTH HOUSE, EALING, W.
October, 1902.

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ESSENTIALS OF DOMESTIC HYGIENE

CHAPTER I

THE DWELLING AND HEALTH

If man is the creature of his surroundings, then nothing in life can have as much influence upon his condition—mental, moral, and physical—as the house in which he lives. In it he sleeps and eats, is born and dies; in it he must spend the greater part of childhood, the most important period of life; while numbers of trades and occupations mean for multitudes of people life in some kind of a dwelling for a large part of every twenty-four hours.

It is a grave and indisputable fact, too, that there is an unmistakable association between certain habitations and special diseases. We hear of 'consumptive' houses, 'pneumonia' houses, and even, according to some authorities, 'cancer' houses, by which are meant dwellings in which these diseases recur again and again, and where they seem to have found a settled home and to have become endemic. Doubtless, in the first instance, the seeds of the disease have been introduced into such

houses by infected people, or by long dresses, boots and shoes, domestic animals, or insects, and then, having discovered just the soil and surroundings necessary to their existence, they have taken up their abode, to become a constant source of harm to successive generations of inhabitants. Sir R. Thorne tells of one house, standing in its own large grounds, which was smitten again and again with enteric fever, the disease attacking in succession different sets of tenants; and although between the second and third occurrence the dwelling had been untenanted for nearly two years, yet a few weeks after the new tenants had arrived the disease reappeared.

The unhealthiness of a house is always a matter of grave suspicion when a particular disease recurs periodically, coming back again and again after longer or shorter intervals.

Perhaps most significant of all are those dwellings in which—though there is never any gross form of illness, yet people are *never really well*; they are always suffering from some small ailment, such as sore throat, headache, rheumatism, or anæmia—they are always complaining of 'little ill-health.'

Low vitality, small recuperative power, a general low state of health, are the commonest results of continued life in unhealthy houses; and these are the worst results, because they go unrecognised for years, and are supposed to be due to constitutional delicacy or some family peculiarity, rather than to defects in people's homes.

The question is therefore of supreme consequence and interest to everyone, How must a house be constructed, arranged, and managed in order that the individuals living therein may keep their health?

True, there is not often much choice about the actual structure, most of us being compelled to live in houses forced upon us by circumstances or chosen for us by others But even then it is of the greatest assistance to know what *ought* to be, and to have knowledge enough to recognise our risks.

Though there are thousands of dwellings in which people are obliged to remain exposed to all sorts of dangers, yet those dangers are terribly aggravated by ignorance and carelessness, and much might be done by individual precautions to counteract and mitigate the evils.

District nurses and all who work amongst the poor are brought into daily contact with unhealthy houses where it is hard enough for the strongest to keep well, and harder still for the sick to recover. In these very dwellings our nurses are called upon to perform their double duty of ministering to the sick and limiting or preventing the spread of disease. It is just under these circumstances that some knowledge of domestic hygiene will be of incalculable advantage. It enables them to detect what is wrong, to discover many indirect and unsuspected causes of disease, to suggest remedies for grievances that cannot be wholly removed, and improvise many a plan by which harm may be lessened and danger minimized.

Two questions, then, must be answered: (1) What are the proper conditions of a healthy house? (2) What precautions or remedies are possible where people are compelled to live in *unhealthy* houses?

The same rules apply to every sort of dwelling. Certain conditions make for health or disease, whether the house be a palace or a cottage. The penalties paid

for insanitation have been as terrible in residences like Windsor Castle as in the slums of great cities. Some of the worst examples of unhealthy houses—veritable hot-beds of disease and culture-grounds for microbes—are to be found in beautiful country districts, where artists love to sketch and tired town-workers seek rest and refreshment. The conditions of life may differ widely, but the principles which govern health are the same for all; and people should remember, when planning holidays or change after illness, that neither seabreezes nor moorland air can make amends for insanitary closets, sewage-polluted water, or sleeping-rooms in which the windows *will not open.*

CHAPTER II

DANGERS OF INDOOR LIFE—DAMP

Damp and disease.

THE first requirement of a dwelling is that it shall be *water-tight.* Damp is known to be associated with consumption, rheumatism, ague, bronchitis, diarrhœa, sore throat, and a host of minor ailments. A damp house depresses health, lowers resisting power, and favours the work of harmful microbes. This fact is proved by the way in which moulds and mildew, 'first cousins' to microbes, flourish luxuriantly in damp situations and appear on walls, books, clothing, and food. The tubercle bacillus, England's greatest enemy, dies rapidly in dry conditions, but keeps its deadly powers for long periods in damp places. Many investigations seem to prove that cancer, too, loves damp; it is very prevalent where the soil is water-logged, in river valleys, or districts liable to constant floods.

We may, therefore, put damp in a foremost place amongst the dangers of an ordinary dwelling.

Causes of damp in houses

Let us notice the more common causes of damp in a house, and the best means of preventing the dangers that may come from the same.

Site and surroundings.

A house may be damp because of its *situation and surroundings.* Low-lying lands, swamps, hollows, river-valleys, marshes, clefts in hills, steep inclines, the banks of rivers where floods occur, the neighbourhood of water-mills, weirs, or any obstacle to the passing away of surface-water are all examples of damp sites.

There may be drainage of surface-water from neighbouring dwellings and gardens on higher ground, or percolation from adjacent ponds or springs which causes damp to find its way underneath the house.

Too many trees in the vicinity of the dwelling may increase atmospheric damp by the evaporation from their leaves, besides obscuring light and air.

Soil.

A house may be damp because of the soil upon which it is built. Damp soils are those which hold water; they are impervious, or only pervious to a very limited extent, and hence keep moisture in their cracks and crevices like a sponge, becoming what is called 'water-logged.' Clay, marl, loam, alluvial drift, or a shallow bed of gravel upon clay are examples of wet soils; while gravel of a fair depth, granite, limestone and sandstone rocks with their cracks and fissures, or chalk on a slope, are all healthy and dry.

What we need is a soil through which water can find its way, so that it does not remain sodden and loaded with moisture after rain.

Damp soils are certain also to mean cold soils, and this has a great influence on health. The temperature of a soil depends upon its power to absorb and retain heat. All moist soils, like clay, warm slowly and lose heat rapidly, while dry soils, such as gravel and sand, warm rapidly and keep their heat longer.

Made soil.

The worst soil of all upon which to live is that known as 'made' or 'artificial' soil. Hollows and waste places, old disused quarries and gravel-pits are sometimes used as rubbish-tips for house-refuse and all kinds of filth. After they have been filled to the ground-level the spots are sold for building purposes, and the 'jerry-builder' runs up his flimsy structures, where people live and die over beds of decaying refuse. This is no overdrawn picture. Of course, in many properly governed places, as within the Metropolitan district, such a barbarous custom is forbidden by local bye-laws. But there are still many districts where nobody cares, and lax authorities make no effort to save the people from this terrible hidden danger. Outbreaks of disease, such as dysentery and diarrhœa, are common results of living upon filthy soil, and if ever old rubbish-tips are used as building sites it must not be until three or four years have elapsed since the last refuse was deposited.

Faults of construction.

A house may be damp *from faults of construction.* There may be no bed of concrete or asphalt under the dwelling to shut out the ground-water. This is a very important line of defence in the building of a house. The layer should be 5 or 6 inches thick, placed over the whole foundation, and extending well beyond the walls all round. This concrete will serve as a floor for cellars, kitchens, or basement. If there is no basement or cellar, then, between the concrete foundation and boarded floors, a space must be left, with ventilating bricks or iron gratings inserted in the walls here and there to allow of free ventilation under the floors. This is the only way to protect boards from dry rot.

Damp often gets into the bottom of a house because the walls below the level of the ground, being out of sight, are made of the worst possible material. It is obvious that this part of the dwelling should be built in the strongest and best way possible so as to keep out moisture.

Damp-proof course.

Another fault in construction may be the omission of a damp-proof course. By this is meant a layer of asphalt, stoneware, or slate and cement, laid in the walls throughout their entire thickness 2 or 3 inches above the ground level. Its object is to prevent the passage of moisture up the walls. Ground-damp will often travel from brick to brick just as moisture creeps up a pile of knobs of sugar if the bottom one is in water, and by this means a house is kept constantly wet.

A dry area.

The damp-proof course interposes a non-porous layer, and above it *no earth should touch the walls anywhere*. Damp is often due to the erection of rockeries and ferneries, or even rubbish-heaps, against a dwelling. There must always be a space, however small, between the walls and any earth, to allow of the free circulation of air all round the building.

Below the level of the ground, in the case of cellars and basement rooms, that part of the wall which must of necessity come in contact with the earth should be coated with asphalt or some impervious substance, or, better still, be separated from the soil by a 'dry area.' By a dry area is merely meant an air-space between walls and earth, and various devices are resorted to, such as double walls with a cavity between, to insure a satisfactory arrangement.

By these three arrangements—a concrete foundation,

a damp-proof course, and dry air-space everywhere above the building—it is possible to entirely shut off the danger of ground-damp.

The ground-water.

There is always a store of underground moisture, known as the subsoil-water, which is constantly rising and falling, being replenished by the rain, and then drawn up again as invisible moisture by the sun's rays. This subsoil-water is always liable to find its way into the house drawn up by internal warmth, especially in winter and at night, and it can only be shut out by waterproof foundations.

The distance of the ground-water can be roughly told by ascertaining the depth of the surface-wells in a neighbourhood, and it is dangerous to build where the water is nearer the lowest part of the dwelling than 6 feet. When, however, this cannot be avoided, the only remedy is to dry the soil. Pervious pipes or channels of loose stones are laid on a slope beneath the surface, and the water running into them is conducted away from the vicinity of the dwelling to some water outlet or safe spot at a lower level. Surface-gutters leading to such drains are of great assistance in drying the soil and lowering the level of the ground-water.

Ground air.

There is another danger which is excluded from our houses by means of the concrete foundation—namely, *ground air*. The soil is full of air where it is not already full of water, and this air is very unwholesome and very different to atmospheric air. It is poor in oxygen, and rich in carbonic acid gas, containing besides, perhaps, foul gases from decaying materials.

Soil air is always finding its way indoors, especially at night. 'The air which fills the soil to a depth of 15 to 30 feet can rise in the course of a single night so

as to constitute a considerable portion of the atmosphere of our dwellings by the early morning.'* Hence the concrete beneath a house is necessary to make it 'soil air-proof' as well as 'soil water-proof.' Besides this, special attention should be paid to the airing of the house, in the early morning, so as to get rid of underground dangers which come from the custom of 'nightly shutting up.'

Precautions where damp conditions are unavoidable.

But what shall we say to the numbers of our fellow-creatures who can have none of these advantages of construction, who are obliged to live on damp sites and water-logged soils, in houses where there is no concrete foundation, damp-proof course, or dry area?

The first and chief precaution is the constant and thorough ventilation of the house, especially of basements and cellars. Wind is the great drying agent of nature, and frequent wind-sweeping is the best remedy for damp.

Basement rooms in a damp house should be used as little as possible, especially for sleeping or for the storage of food. The higher rooms in a damp house will naturally be the least affected.

The opening of the house in the early morning, so that every part of it is flushed with a good current of air, will be a great counteraction of night damp. It will also be a very real safeguard against damp, as well as against other dangers to be mentioned later, if one window on a staircase or landing, or somewhere in the body of the dwelling, is always kept open, so as to provide a constant outlet for the escape of harm.

Extra care must be taken in damp conditions to see

* Dr. Monkton Copeman.

that no earth actually touches the walls. It is generally easy to dig away enough to allow a small passage between, and, however rough and crude the arrangement may be, all that is wanted is to secure the drying influence of the air round the walls.

Even if there is no concrete beneath, it is simple and inexpensive to put in ventilating bricks beneath the ground floor between the boards and earth. Thus fresh air can circulate through the space, and soil damp and air will be able to find an escape before they affect the dwelling.

Surface gutters are easily devised for the carrying away of water which might stand about the house.

Vegetation and plant life round a dwelling also help to counteract damp by clearing and drying the soil. The common sunflower, the eucalyptus, oak, and willow have all a special drying and cleaning power on earth.

Various causes of wall-damp.

There are other faults of construction which must be noticed as possible causes of damp.

In the jerry-built houses run up by unscrupulous builders, not necessarily only for the poor, walls are often built in so thin and flimsy a manner that damp can drive through them. A brick will absorb as much as a pint of water, and external walls ought never to be less than a brick and a half—*i.e.*, 14 inches thick.

Wall damp can also be excluded by covering the exterior surface with some protective material—paint, stucco, cement, tiles, slates, or even pitch. Houses in exposed positions should always have such an external coat.

Defective eaves and window-sills which do not project enough to throw the water clear of the walls; badly

constructed or dilapidated roofs; deficient gutters, made, perhaps, of wood instead of metal; the choked heads and gutters of rain-water pipes which are never cleaned; leaky rain-water pipes not carried down to the bottom of the walls—these are all common causes of wall damp, especially in old houses. Most of them are easily remedied. Rain-water pipes ought specially to be looked after, as they are often the cause of damp. Their gutters and pipes should never be carried *through* a house, or round it *inside* the walls and through the rooms. They should be made of galvanized iron, and should receive the water direct from the eaves, conducting it away clear of all walls to a properly ventilated rain-water tank, or to a grating-covered gulley leading to a drain. These rules about rain-water pipes are of great importance, and where defects exist they are generally cheaply and easily remedied.

Worst of all, the damp patch in a wall may come from a leak in some soil-pipe, drain, trap, or water-closet; from some defective earth-closet or refuse heap placed against the outside of the house; and no one has guessed the double danger of such damp until diphtheria or some other deadly illness has brought sorrow and experience to the inmates.

No sign of damp in the walls of a house should be ignored; the cause is often easily remedied, and the harm done may be so much greater than we imagine.

Areas and yards.

All yards and areas about a dwelling should be so paved and drained as to prevent water ever standing in hollows or on flat surfaces. This is now known to be a health measure of the first consequence. The surroundings of a dwelling must either be evenly and imperviously laid and sloped to a

trapped pipe, or else cultivated as a garden. Even when soil is polluted it has been proved by experiment that vegetable and plant growth not only cleans it, but is destructive of the malignant microbes that may flourish in such soil, especially that of typhoid. Gravelling and rolling ground round a house is not sufficient; paving or cultivation is essential to health.

Customs and habits that cause damp.

Yet one more cause of damp in houses may be found in *the habits of the people.* Dirty water from house-cleaning—sometimes even bedroom slops—are thrown on to the ground round the house, or on to the ashpits or rubbish heaps near. Old papers are left on walls when repapering is done; clothes are dried or aired in rooms with closed windows; damp papers, rags, and other rubbish are stored away behind furniture and under beds.

The old-fashioned plan of 'swabbing' floors and soaking boards with water, as a method of cleansing, must be condemned as absolutely unhealthy and lacking in all common-sense. Surfaces made wet must dry partly by evaporation, and this unseen moisture from wetted boards and stones, just as from damp clothing, will get absorbed by furniture, drapery, and clothing, giving rise to rheumatism, children's 'growing pains,' and many an ailment caused by damp.

Much prejudice has to be encountered about this subject of cleaning the house, but we are bound to try our utmost and teach that there is no necessity to use much water; *damp* cloths and flannels well wrung out, damp scrubbing-brushes with water well shaken out, will take the soap just as well and clean far better than sopping cloths and brushes, and pools of water. Oil-cloth, linoleum, and such materials will last much longer

and keep their colour and gloss much better if only very slightly damped, soaped, and then well rubbed and polished. 'All very well for new floors,' argued an old East London housewife, 'but if your boards are very old and very dirty, like mine, you must use quantities of water to get them clean.' But the answer is, Use as much water as you like, but do not put it *on* the floors. The flannel can be constantly rinsed, wrung out, and the water frequently changed, but still there is no necessity to throw water on the surfaces.

'Dry cleansing' is far safer and better than 'wet cleansing.' If it is considered absolutely necessary to wash a floor, then a good drying day must be chosen, when doors and windows can be put wide open, and the whole left to dry in a good current of air.

This especially applies to nurseries, because of children's great susceptibility to damp; and to larders, because food will keep fresh as long again if the surroundings are thoroughly dry.

It is a great consolation as we leave this subject of damp to notice how much rests with the individual. Many of the most common causes of damp in a house are entirely avoidable or remediable. Wind and sunlight are Nature's drying agents, God's greatest gifts to man. So powerful is their action that even a damp house may often be made fairly healthy and safe if these friendly influences are allowed to do their work. Rooms, passages, stairways, even cupboards and closets, should be flushed with fresh air, blinds and curtains drawn to their utmost capacity to allow of the admission of sunlight, and by this means much injury from damp may be entirely avoided.

CHAPTER III

THE INTERNAL STRUCTURE AND ARRANGEMENTS OF THE DWELLING.—THE DANGERS OF DARKNESS AND DUST.

EVERY detail of the inside of a house becomes worthy of consideration when we remember the influence of home on health.

Wall-coverings.

The inner surface of walls should be covered with something smooth and non-porous, so that they may not absorb moisture or collect dust, and in order that they may be easily cleaned. Whitewash is simple, but leaves a rough, porous surface, and even in outbuildings needs constant renewal.

Limewash is better. It should be used for all basements and outbuildings, and is far healthier for crowded rooms than paper. The old dirty coat must always be scraped off before a new one is put on, and the limewash can be coloured to suit any taste and mixed with size to prevent its rubbing off. The expenditure of a few pence will buy sufficient limewash to coat walls and ceilings once in three months, and rooms can thus be kept sweet and fresh.

Distemper is a very good covering for bedroom walls. Its great advantage is that it can be so inexpensively and easily renewed.

Wall-papers

If paper is used, it ought to be of a smooth and non-porous kind that will bear washing and dusting well. A dado and frieze of a washable glazed paper, with a coat of distemper or coloured limewash between, makes a healthy and pleasant wall covering.

In bath-rooms, lavatories, closets, and larders, unless tiles can be afforded, distemper is best for walls. If ever either of these apartments are papered, it must be with something of the sanitary or washable kind, or else the paper must be varnished.

Wall-papers should not be supposed to last too long, especially in bedrooms. Even under the best management, walls collect a good deal of dust and decaying organic matter from condensed human breath, and an old wall-paper in that condition has been proved by experiments to make excellent growing ground for disease germs, especially the microbe of consumption. Therefore cheap papers, which can often be changed, are best. The old coat must always be entirely removed before repapering. The unpleasant smell in some rooms is often due to the layers of dirt and damp fermenting paste shut in between old papers. Light-coloured papers are better than dark ones, because not only do they make a room brighter and more cheerful, but they show dirt and dust more quickly, and are more likely to get changed.

Test for arsenic.

If a bright-coloured paper is chosen, it is well to ask for a guarantee that no arsenic has been used in its manufacture. A test can easily be made if there is any anxiety. About 2 inches of the paper are cut into small pieces and put in a test-tube, which is partially filled with water,

containing two teaspoonfuls of pure hydrochloric acid and a small piece of copper-foil. When the test-tube has been heated over a spirit lamp for a few minutes, the colour of the copper-foil will change to a blue or dark steel hue if any arsenic is present.

Many foolish ideas exist about 'waterproof' papers or wainscoting as a remedy for damp. If walls are damp *the cause must be removed*, and then all old coverings scraped off and the whole left to dry under the influence of wind, light, and warmth, before anything is put upon them. There is no other way of remedying damp in walls.

Ceilings. Ceilings are generally plastered and white-washed. They need frequent cleansing and fresh whitewashing if a room is to be wholesome. Papered ceilings are not advisable because they do not quickly soil, and are liable to be left longer uncleaned.

Chimneys. Chimneys, if straight, round, with smooth interiors, and separate from each other, are a great help in the ventilation of a room. For this very reason they should be often swept, as soot interferes with the free passage of the air. No drain ventilators should terminate either in a chimney or close to its opening, as sewer gas may thus find its way into the house. Chimneys should be carried up not less than 3 feet above the roof; if they are below the level of surrounding buildings they should be lengthened by a piece of zinc piping, with or without a cowl, to prevent the discomforts of down draughts and the injurious effect of smoke. If there is a fireplace in a room, one of the first things to notice is whether the register is open and the chimney unblocked.

Floors.

Floors ought to be made of some impervious material. Stones or tiles should be laid evenly and kept in a state of repair, so that no crevices or depressions hold damp and dirt. Wooden floors are often abominably laid, green wood is used, which shrinks so that the boards gape apart, and draughts and unpleasant smells come from the spaces between boards and ceilings. Well-seasoned wood ought to be used, and the boards laid to meet exactly and to fit well with the skirting round the room. Where this has not been done, the spaces can be filled up with tow, and the whole varnished over.

A remedy for gaping boards and draughty floors is to cover the whole with linoleum (or cork carpet where it can be afforded), and this should be laid to fit well into the wainscot and to completely shut off the space beneath. The gain from such an air-tight covering in comfort and warmth is very great, but care should be taken to have air-bricks placed to ventilate the space beneath on the principle, which must be constantly repeated, that there should be no closed spaces in or about a house which are not freely ventilated.

All boarded floors are healthier if stained and varnished, or polished with beeswax and turpentine, so that rugs can be used which can be taken *outside the house for shaking*. In any case the outer margins of floors should be varnished, so that squares of carpet can be used instead of an entire covering.

The fewer angles, corners, recesses, and deep cornices, the better. We must seek strenuously to avoid everything both in the construction and arrangement of the house which can collect and harbour dust.

It is a pity that more space is not given in building

to stairways, landings, and entrance-halls. On however small a scale the dwelling is constructed, these form the 'lungs' of the house, and are the best means of ventilation. If we can choose, it is far better to have small rooms and a well-lighted, well-aired entrance passage and staircase than large rooms with the narrow, dark halls and passages so often found in London houses.

Height and number of rooms.

In regard to the height of rooms, it must be remembered that *airiness* and *loftiness* do not by any means signify the same thing. There is no great advantage from the health point of view in having ordinary rooms above twelve or even ten feet high. Impurities in room-air are heavy and tend to lie low, somewhere about the level of people's heads, and those who have lofty apartments are apt to trade upon the fact and ignore the necessity of ventilation.

The number of rooms in a house is an important factor in its healthiness. We all know of the grave disadvantages —physical as well as moral—of life in one room. It is far healthier to live in two small rooms than in one that is much larger, if for no other reason because the two can be *used and aired alternately*.

The use of rooms.

This advice is not only needed by the cottage dweller who lives in the back kitchen rather than use 'the best parlour'—a room which is kept shut up with blinds down, windows fastened, and probably chimney register closed, ready for best occasions. There are numbers of other people who live in houses with many rooms at their disposal, and who yet drift into the habit of living almost entirely in one room, keeping others for guests or special occasions.

Every room in a house should be constantly used, unless there are damp rooms in basements, which should,

of course, be much aired but little used. If there are two or three sitting-rooms, they should be lived in alternately; a change of room is good for the inmates, and use keeps rooms from becoming damp and fusty. Everyone knows the stuffy smell of stagnant air in the shut-up spare room, whereas, if somebody slept in it now and then as a change from their own room, it would be an advantage all the way round, especially to the guests.

It is a great boon to the members of a family for each to have his or her own sleeping apartment. A small separate bedroom, provided it has a window that will open, is infinitely healthier than a larger room shared with others.

But for many people the luxury and health benefits of several rooms is not possible, and all we can urge is that they should use the rooms they do possess, and avoid the habit of living in one special room or of keeping any apartment in a house shut up.

Sunlight.

One most important consideration in a house is sufficiency of daylight. Darkness is a serious danger of indoor life. Everyone knows that light is a primary need of existence, that deficiency of light means, for human beings, as well as for plants, loss of colour, strength, and resisting power. Besides this, recent discoveries have brought to us the wonderful knowledge that sunlight is a powerful disinfectant, and destroys disease-producing microbes, such as those of tuberculosis and diphtheria. Out of doors the light of the sun, together with the oxygen of the air, slaughters myriads of microbes daily; it is only indoors, where sunlight cannot penetrate, in the dark recesses and semi-twilight of people's rooms, that pathogenic germs retain their deadly power, sometimes for years. Hence it becomes

a serious responsibility to do everything possible by construction, arrangement, and management to fill our houses with light.

The best aspect for a house is east and west. We then get the benefit of morning and afternoon sunlight.

The more window space the better. The area of a window in living rooms should *never be less* than one-tenth of the area of the floor space, and must always get its light from the outside. No borrowed lights or skylights are fit for living or sleeping rooms. The test of the proper daylighting of rooms is that all ordinary occupations—reading, writing, and needlework—can be carried on in any part of the room with perfect ease. A well-lighted landing or staircase is of great value to the house, and the lightest rooms of all should be the nursery and school-room. Children, like plants, want all the light they can get for purposes of growth and development.

In arranging rooms the question of light should be a chief point of consideration. When there is choice, the rooms most used in the morning, especially breakfast-rooms, should have an eastern aspect.

A drawing-room may with advantage face west, as it will probably be more used in the latter part of the day; but nurseries want morning and midday sun, and bed-rooms facing east secure the priceless benefit of early light and warmth.

It may be worth while here to notice that lessons learned from the open-air treatment of consumption have led to many changed ideas about the temperature of sleeping apartments. So long as people are well fed and sufficiently covered, so long as the bedroom is well supplied with fresh air, a low temperature does not signify, excepting in some special cases of illness; and

the thermometer in the bedroom of a person in health may stand safely at only a few degrees above freezing-point.

Even in sickness cold is not felt half as much while lying down, because of the more equalizing effect of this position upon the circulation.

Hence we need not fear an eastern aspect for a bedroom on the ground of cold ; indeed, those people have much to be thankful for who wake with the morning sun streaming in at their windows.

Landings, kitchens, and larder can all face north, while the best aspect for a sick-room is south-east.

Customs which exclude light.

But in regard to this indoor danger of darkness, even as in the case of damp, the chief cause of harm lies often in the habits of the people themselves. Blinds are drawn to protect carpets and furniture, windows are heavily draped with curtains and filled up with plants ; every device seems to be adopted for the exclusion of the sun's rays. After the cold, dark days of winter, when every part of the house needs all the warming, drying influence of the spring sunshine, sunblinds are put up, and arrangements made for darkening and cooling the house, which are only permissible in the oppressive heat of August.

All customs which exclude light from houses must be condemned as contrary to health laws ; and if we could have the very best conditions, we should choose for our dwelling one which had the direct sunlight upon some part of it at all times of the day. A house that never gets any direct sunlight is not fit for human habitation ; and all who work for the mental, moral, and physical good of the people must wage incessant warfare against cellar dwellings, basement sleeping apartments, under-

ground bakeries and workrooms, and all dark and sunless habitations.

Bedrooms. Allusion has already been made to the importance of a bright sunny aspect for a bedroom. There is no more important room in a house. Even if people are obliged to spend all the working-day in unhealthy places, a dry, well-aired sleeping apartment will go a long way towards counteracting ill effects.

The higher up in a house the better its position, and this especially applies to malarial and damp districts. When poisonous exhalations find their way into the dwelling, they are apt to accumulate in the lower parts; persons and animals sleeping in basements and on ground-floors have often suffered where those higher up have escaped.

Besides a window which opens top and bottom, or on both sides if a casement, a bedroom ought to have a fireplace or some grating or shaft-ventilator as an outlet for stale air. Doors must never be relied upon for purposes of ventilation; bedroom doors must always be kept shut except during the hour in the early morning, when everything is open for thorough airing.

A bedroom should never be next to a closet, and when this is unavoidable, care should be taken to ascertain that the separating wall is well finished beneath the floor, and not merely made of lathe and plaster, as is often the case.

The floor should be covered with linoleum, or cork carpet when expense will allow, then mats can be used for comfort where necessary. Carpets are not healthy in bedrooms, and, if used, should only be in the form of movable squares, with a margin of oilcloth or varnished boards.

The furniture cannot be too plain and simple—everything should be smooth and easily accessible for moving and dusting. Spaces behind heavy furniture, recesses and nooks in the tops of wardrobes, and all such obscure corners, harbour dust, and give the room a stuffy, unwholesome smell.

If health is to be considered, a bedroom ought not to be a sitting-room. Dr. Clifford Albutt has recently described a sanitary bedroom as 'merely a shelter for the bed, and for dressing and undressing.'

The bed. The bed itself should be a very simple matter. Mattresses are far more healthy than feather-beds. Bed-clothing should be light, but warm enough to suit the comfort of the individual. No two people are alike in their requirements on this point. When we remember that, according to modern knowledge of health laws, *a bedroom window should always be open* even in the depth of winter, and that the wider it is open the better, it is easily recognised that more bed-covering is required, and that no hard and fast rule can be made about the amount allowed, excepting that a cotton coverlet is as unsuitable at night as a mackintosh sheet, and should, of course, always be turned back. When there is any tendency to rheumatism, it is often an actual cure to sleep in a blanket instead of between sheets. The strictest rules should be enforced in the matter of thorough bed-stripping, and the exposure of all covering daily to light and air.

Separate beds are essential to healthy sleep. Even children should not sleep together. Apart from many grave moral considerations, people require such different conditions for comfortable sound sleep, different positions, light or heavy bed-clothing, high or low pillows, and

it is exceedingly unhealthy to inhale the breath or be in contact with the skin exhalations of another person during the night's rest; so that, even in those crowded bedrooms well known amongst the poor, where many people must occupy the same apartment, earnest efforts should be made to induce them to devise separate beds, however crude and simple.

Light iron bedsteads are best, with wire chain-mattresses, without valences or drapery, except, perhaps, light curtains round the head to protect from draught. The position is best with the light on one side, and with only the head of the bed near the wall, so that air can circulate below and round. In houses where the old-fashioned four-poster is a precious heirloom and cannot be discarded, people should be persuaded to have the upper part cut away, valences and curtains removed, and the danger of stuffiness and dust minimized as much as possible.

Muslin or lace curtains to bedroom windows are an actual advantage, especially in towns; they can be drawn across open windows at night to filter incoming air during fog and damp. The frequent washing of curtains in towns and suburbs must be accepted as a definite part of the health arrangements of the house.

Distemper or varnished papers have been noticed as best for bedroom walls; and whenever it is possible to have venetian blinds there is no greater help towards the ventilation.

An occasional fire in a sleeping apartment is a great help towards its purification.

Overcrowding in bedrooms is met with continually, not only amongst those who have no choice in the matter, but in the night nurseries, school dormitories,

and servants' bedrooms of better-class houses. Four hundred cubic feet of air space per individual is the very lowest that can be recognised as safe, and this only when windows are kept open and there is thorough ventilation.

A screen is almost indispensable in the average bedroom. The bed is often too near a window for it to be possible to keep a good air supply without draughts. A screen placed between the bed and window enables us to get over the difficulty at once.

Nurseries.

Many of the rules suggested for sleeping rooms apply equally to nurseries and home schoolrooms. Once upon a time any odd room in a house, perhaps in the basement itself, was thought good enough for the children; but childhood is now recognised as the most important period of life, when the individual is more influenced by his surroundings than ever after. A large built room, high up in the house, with plenty of sunlight and good means of ventilation; a cheerful, washable paper; simple light furniture; a square of carpet securely fastened, but easily taken up for shaking outside, with a border of linoleum or cork carpet—all such hygienic arrangements will give the child its best chance of growth and development, and help to fortify it for the physical difficulties which beset life's early years.

The kitchen and its accessories.

One other room in a house deserves special consideration. The place where food is prepared cannot be too carefully arranged and managed. Whether it be in the basement or above ground, it should be provided with a good-sized window, opening to half its size and communicating direct with the external air. Sculleries, washhouses, and closets should be entirely shut off from the kitchen by closely-fitting doors, and have their own openings to outdoor air.

A coal cellar ought not to be indoors at all. Much ignorance prevails on this point. Architects and builders seem unaware of the importance of arranging definitely for the storage of coal *outside* the house. Coals give off a certain amount of gaseous effluvia and dust, and this should certainly not find its way into the kitchen or larder. If coal must be stored within the dwelling, then the place devised must have an opening for ventilation and a closely fitting door.

The walls and ceilings of the kitchen and its surroundings should be kept scrupulously clean by frequent scraping and renovating. The door between a kitchen and the rest of the house should always be kept shut, and if it is in the basement the passage or staircase leading from it should be well ventilated, and the door at the end kept closed. Smells of cooking and hot air from the kitchen should be, as far as possible, shut off from the rest of the dwelling for the sake of comfort and appetite.

Dogs, cats, and birds have no place in the room where food is prepared. We have only to know something of the illnesses to which such domestic animals are liable, and which they can, by many channels, communicate to man, to realize that they should never be allowed an opportunity of touching food or food utensils used by ourselves. The water-supply and drainage appliances connected with kitchen apartments must be discussed in a future chapter. Suffice it to say here that if we would have a healthy home, the places where food is kept or prepared should be especially clean, light, well ventilated, and free from a trace of impurity.

The cleansing of the house.

Scrupulous cleanliness everywhere must be the law of a healthy house, in places unseen as well as seen; in attics and cupboards,

as well as in dining and drawing rooms; behind pictures, as well as on tables. But knowing the assistance that damp gives to microbe life—remembering that dust is the chief germ-carrier in nature—we must carefully avoid these two indoor dangers of damp and dust in all our methods of cleansing.

'Damp cleaning' and 'dry rubbing,' as opposed to the old-fashioned extensive 'washing,' has already been emphasized. Plenty of soap, constant change of water, energetic polishing, but no real wetting of surfaces, should be the rule. Damp dusters should be used for removing dust whenever possible; the less sweeping inside a house the better. Carpets, rugs, and mats should be of such a size, and be so laid, as to allow of their being taken outside for sweeping or shaking. Patent carpet-sweepers, which collect the dust in closed boxes, are admirable for daily use, and if the weekly 'turn-out' of a room renders a thorough sweeping inevitable, then windows must be opened wide, doors closed, light dust-sheets used for covering furniture, and damp tea-leaves—previously washed in clean water—should be freely sprinkled about to gather up the dust. Everything from a dust-pan should be immediately burnt. Doormats should be beaten as far from windows and doors as possible; boots should be brushed *outside* the back-door; dress-skirts, when in need of brushing and shaking, should be dealt with *outside* the house, or, at least, not—as is often done—on the kitchen table!

In all these seemingly trivial matters we have to recollect one special danger. So long as men spit anywhere and everywhere, and so long as consumption is rife in our midst, we have always to reckon dust, brought

in on boots and clothing from pavements and surfaces out of doors, as the great channel by which a dreadful disease is constantly finding its way into our homes. Hence in all our plans we must aim at keeping dust *outside* the dwelling as far as possible.

Spring clean.

Some writers on domestic subjects object strongly to the annual upheaval known as spring clean. They argue that if a house is well managed there is no need for so great a periodical disturbance. But there is much to be said in favour of the old custom. Besides the importance of attention to matters which cannot be managed every day—such as book-dusting, chimney-sweeping, extra cleaning of walls and paint, and the overhauling of beds and bedding—there is a distinct gain to the healthiness of the house in the general 'turning out,' which means the destruction of large quantities of rubbish. There should, of course, be no obscure corners, private darknesses, and rubbish cupboards in the dwelling; but it is very difficult to prevent accumulation of papers, rags, old clothes, and such things, about which the economical mind always argues that 'they may come in some day.'

Spring clean brings the yearly opportunity for a general clearance and purification.

Dilapidations.

Finally, let us notice in regard to our dwellings that the older they get, and the more they are used, the more care and attention do they require. The need of repairs should never be neglected if the means lie within our reach. Worn and defective surfaces, cracked ceilings, wrinkles and cracks in papers, shrunken boards, all collect dust, make cleaning difficult, and harbour infectious germs. Dilapidated dwellings are responsible for many of those

sporadic cases of disease which perplex and surprise us, but which might often be traced to the crannies and crevices of an old house in which the infective germs of bygone illnesses have found a shelter for years, ready to seize on any favourable opportunity.

CHAPTER IV

OUTDOOR AIR AND NATURE'S LESSONS

BEFORE proceeding to notice that fourth danger of indoor life—'damaged air'—to which we owe so large a proportion of the ailments of life, it is well to remember some of the simple facts about outdoor air, and to notice the lessons they teach us.

Everybody knows that air is man's chief need—his first want at the beginning, his last want at the end of bodily life. He may manage for three weeks without food, for three days without water, but never three minutes without air. He draws his supplies from an inexhaustible store which surrounds the earth's surface—a great invisible ocean of air, at the bottom of which he moves and lives.

Physical properties of air.

Some of the physical properties of air suggest valuable lessons for indoor life.

Besides being invisible, colourless, and tasteless, common outdoor air is *inodorous*. There may be scents from trees and flowers, sea or soil, but fresh air has no smell of its own, and this fact is worthy of note, because indoor air, when fresh, will likewise have no smell.

Air has weight. This can easily be demonstrated by

exhausting a bottle of air and weighing it before and after. The force with which it presses is almost 15 pounds ($14\frac{3}{4}$ pounds exactly) upon every square inch of surface; that would represent a pressure of some 14 or 15 tons upon the body of a person of average size. We are not conscious of this weight; even so light a body as a soap-bubble floats safely through the air, because the pressure is equal on all sides, and therefore evenly balanced. But air-pressure has to be taken into account when we devise plans for ventilation or for the keeping of water in traps under sanitary appliances and along lines of drains.

The weight or density of air is not always the same. Cold air is heavier than warm, and dry air is heavier than moist air. Hence we get the many continual variations in atmospheric pressure which affect the health of man, the conditions of the soil, and weather changes. Alterations in the weight of air are measured and recorded by the barometer, the mercury in the tube rising and falling according to whether the air is heavier or lighter.

Air also possesses elasticity. When warmed it expands and becomes lighter; as it cools it contracts and becomes heavier. This power to expand and contract explains why the air-ocean is *never still.* Portions warmed by the sun or by contact with the warm ground expand and rise, while colder, heavier portions flow in to take their place, and thus we get all those wondrous air-movements, from gentle breezes to trade winds and cyclones, with which the peoples of the earth are acquainted.

Yet another physical property of air to be noticed for our special purpose is its *diffusibility.* In obedience to a great law of Nature known as the law of diffusion, all gases of different weights and temperatures diffuse and

mix with one another, and even if one is very heavy and the other exceedingly light they will slowly intermingle until the whole is of the same composition. If the air outside a house contains a different proportion of gases to the air within, as it generally does, then, when the window is open or the chimney left unblocked, or even through keyholes or cracks under doors, a slow intermingling will take place between the fresh and the stale air, and by this means *some* purification is effected.

But the rate at which gases diffuse is influenced by their weight, and this, as we have seen, is affected by temperature. Hence the air outside a house will affect that which is within far more readily in winter than in summer, because there is sure to be a greater difference of temperature between the two. This explains why it is that a house is often better ventilated in winter than in summer, in spite of the fact that windows are more likely to be kept open in hot weather.

Composition of air.

When we come to examine the composition of air we find that it is a mechanical mixture of certain gases. Its component parts are only loosely combined, and easily separated, not, as in a 'chemical' mixture like water, closely united so that they make something totally different to themselves.

The chief gases which enter into the composition of air are nitrogen, oxygen, and carbonic acid gas. If we analyze 10,000 parts, we find the proportions to be:

Nitrogen - - -	7,900 parts
Oxygen - - -	2,096 ,,
Carbonic acid - -	4 ,,
Total - -	10,000 parts

There may be traces of other matters present—ammonia,

water-vapour, ozone, salts, a very simple gas known as argon, together with varying quantities of organic and inorganic impurities, and microbe life.

Nitrogen. Nitrogen, which constitutes so large a proportion of common air, is an inert sluggish sort of gas, of no direct use to human life, and evidently intended to dilute and modify the active oxygen.

Oxygen. Oxygen, which makes up one-fifth of the composition of natural air, is a marvellous material, necessary to every form of life upon the earth. The small amount dissolved in water serves for the life of all fishes and aquatic animals, and the small quantity found in the air ocean is sufficient for all the animal creation.

It is the gas which makes combustion possible, and whenever anything burns—coal, wood, oil, even a night-light—we may be sure that oxygen is being used up in the operation.

Oxygen is the particular ingredient in air which man and animals require for existence, and it has sometimes been designated 'vital air,' as being the only part which gives to air its power of sustaining warmth and life.

Carbon dioxide. Carbonic acid gas, composed of carbon and oxygen in the proportion of 1 to 2 (CO_2), forms a very minute part of common air. It is always produced when anything burns. Whether it be the coal in the grate, the oil of the lamp, the wax of the candle, or the food within the bodies of animals, the results of oxidation or combustion are the same; oxygen is used up, carbonic acid is given off, while heat, and sometimes light, are the outward manifestations. Carbonic acid gas is heavy—one and a half times heavier than air—hence it mixes slowly with other gases, and

tends to collect at the bottom of wells and mines, and in the lower parts of rooms.

If present in large quantities it is poisonous, but the normal amount found in outdoor air—4 parts per 10,000—is perfectly harmless to human life, and an increase to 6 parts per 10,000 can be borne without injury.

Ozone. Ozone, of which traces are sometimes present in outdoor air, is a very powerful concentrated form of oxygen. It has a strong smell, and such cleansing and purifying properties that it has been called the scavenger of the atmosphere. It is only discoverable in very pure, fresh air, far from the neighbourhood of rubbish-heaps aud decomposing materials. Indeed, the very existence of ozone is a proof of the purity of the air, and of the absence of decaying substances. Fresh country air is said to contain about 1 part in 700,000 of this wonderful gas.

If strips of blotting-paper, soaked in a mixture of potassium iodide and starch, be exposed to the air they will turn a blue colour should ozone be present. This is only a rough test, but it has enabled investigators to show that ozone is more often present in suburbs than in towns, on mountain-tops than in plains, near the sea-shore than on flat inland surfaces.

Water-vapour. A certain amount of moisture is always found in air, owing to the constant evaporation going on from land and sea. The amount varies at different seasons, but, generally speaking, the proportion is about $1\frac{1}{4}$ per cent.

Some moisture in air is essential to health; perfectly dry air is unbearable, and this fact must be remembered indoors as a reason for caution in the use of stoves or any form of heating which dries the atmosphere. It is

also another reason for that important health rule: 'Breathe through the nose.' The air, by its contact with the mucous membrane of the nasal chamber, becomes not only cleaned and warmed, but more moistened than it can possibly be if it takes the shorter journey to the lungs through the mouth.

Microbes in air.

Multitudes of microbes are constantly passing into the air from the earth's surface, carried by wind and travelling upon dust, probably over great distances. Their numbers and kind depend greatly upon locality, season, time of day, weather, and other conditions. They are lessened by rain, and greatly increased by long periods of drought, are fewer in winter than summer, and diminish with elevation and distance from populated areas. Pathogenic microbes are always increased by any processes of decomposition; the bursting of bubbles of gas from collections of putrid matter cause multitudes of germs to be cast into the air. But in outdoor atmosphere harmful bacteria are only few in number compared with those that are serviceable to man, and even those that are most malignant are weakened and destroyed by oxygen and sunlight to such an extent that they constitute no danger unless near sources of impurity, like scavengers' carts and other foul accumulations.

Impurities in outdoor air.

Of the varying quantities of solid and gaseous impurities sometimes present in outdoor air we need not particularly speak.

In low-lying and thickly-populated districts, over dusty and unscavenged streets, in the neighbourhood of smoking chimneys and manufactories, great quantities of soot, dust, and all sorts of additional impurities are likely to be found, and it is their presence in greater or less degree

which constitutes the difference between town and country air.

In the air of localities where there is much decaying nitrogenous material a large amount of ammonia may be present. In towns where much coal and gas is burnt, or in the neighbourhood of gasworks, materials such as sulphuretted hydrogen are often found in sufficient quantities to injure or kill shrubs, trees, and grass. In the air of marshy districts poisonous matters may give rise to ague and malarial fever.

Even under these special circumstances poisons in outdoor air are quickly diffused, diluted, and rendered harmless. This brings us to the most wonderful of all facts connected with the atmosphere—namely, its *constant fitness for use*, its evenly-balanced composition.

Agencies by which outdoor air is kept pure.

Thousands of contaminating influences are always at work round the surface of the earth. Carbonic acid gas is unceasingly given off by combustion, by decaying processes, by the respiration of man and animals, by the very soil itself. From multitudes of chimneys, outlets of drains and masses of putrefying refuse, poisonous materials are contributed to the air. Yet its balance is steadily maintained. Whatever the district may be like in which we are compelled to live, of one thing we can be sure, outdoor air will always contain sufficient oxygen for our needs, and the impurities will never collect in such abundance as to constitute any serious damage to health.

How is the miracle accomplished? Nature's agents for the purification of outdoor air are rain, dew, and snow, oxygen, sunlight, plant life, diffusion, and air movements. Like busy fairies, these forces are always at work on our behalf in the great laboratory of Nature.

Rain, dew, and snow clean and freshen the air. Rain especially in its passage washes down soot, dust, and other solid impurities, dissolves any ingredients of a soluble kind like ammonia, and carries them to the earth for the nourishment and life processes of plants.

Oxygen and ozone seize upon the products of decomposition, and take away from harmful materials their capacity for doing mischief by changing them into simple harmless substances.

Sunlight, as part of its great purifying and life-giving work, destroys disease-producing microbes, and acts as a constant disinfectant.

Plants, by means of the green chlorophyl grains in their leaves and stems, are hard at work wherever there is sunlight, splitting up carbonic acid gas into its component parts, using the carbon for themselves and setting free the oxygen for animal use. It has been calculated that half an acre of forest land wil[1] use up the carbonic acid gas produced by the respiration of seven men.

By diffusion, poisonous gases are moved away from crowded streets and inhabited areas to be dealt with by plant life in gardens, parks, and the surrounding country, and fresh and stale air are constantly intermingling.

Air movements.

But most powerful of all amongst these purifying agencies are air movements.

Stillness in nature means death, and if outdoor air were ever perfectly motionless it would become like still water, stagnant and poisonous. Even on a calm day in summer, when scarcely a leaf seems stirring, there are ceaseless invisible movements going on in the air ocean. Portions warmed by the sun's rays or by the heated ground become lighter and rise, while cold, heavy currents rush in to take their place. Sometimes the move-

ment is so gentle as not to be perceived, sometimes we feel the terrific strength of moving air, as mighty winds and hurricanes sweep over the land with devastating power.

By these irregular but unceasing movements the atmosphere is constantly purified and refreshed. It is said that if on a still day the air of London or some other great city could be carefully watched, it would be found that, even in the calmest weather, streams of fresh air are flowing in from the country round down all the suburban streets and outlets to take the place of those currents which, heated by the vast city, have risen upwards.

When we reflect how soon a cloud of smoke is dispersed, an offensive smell wafted away, or a volume of dust dissipated, we see how marvellous is the purifying influence of air movement.

So, by a wondrous system of self-purification, the outdoor air remains always fit to breathe. People do not act as if they believed it. They open their windows and front-doors, and live in a well-aired dwelling when away in the country or at the seaside, but directly they return to town or suburban life they shut themselves up and argue that 'town air, with its dust and dirt, is better kept out than in'! There are a number of ailments supposed to be incidental to town life which need never be endured, and would have no more connection with town than country dwellings if only people could be induced to believe that *everywhere*—in streets and courts, as well as fields and lanes—outdoor air contains the life-giving, invigorating oxygen, and is always fit for man's wants.

Night air. It seems strange that in these days of increased knowledge it should be necessary to say one word about night air. But as there are still

people who bolt and bar their houses as much from night air as from burglars, we must take care to constantly teach that night air is as fit to breathe as day air. This is no question of personal opinion or private fad. The fact has been demonstrated repeatedly and under all sorts of circumstances, that even in illness we want and *must have* outdoor air at night as well as by day. Some of the most delicate people have become strong in lung power and lost all susceptibility to cold by accustoming themselves to sleep in wind-swept bedrooms. Some of the most remarkable successes have been achieved in the treatment of consumptive patients by putting them to sleep in the open air.

CHAPTER V

THE AIR-SUPPLY OF THE DWELLING—THE DANGER OF DAMAGED AIR

The danger of damaged air.

WE are completely at the mercy of this fourth danger of indoor life whenever it is present. From damp, darkness, and dust we may find means of temporary escape, but air is the absolute necessity of every minute's existence. Bad or good, we are bound to use it; there is no choice, no time for consideration.

Unfortunately, too, damaged air is an invisible danger. No power but the sense of smell can warn us of its presence, and this sense gets so easily blunted, so quickly accustomed to its surroundings, that it is practically useless to numbers of people. There is nothing evil under the sun to which we can grow more quickly reconciled than the breathing of vitiated air; and when once we are hardened, there remains no other warning of our danger excepting its disastrous effects on health, which creep on too slowly and insidiously to be often recognised or put down to their true cause.

Sources of harm to indoor air.

The air that finds its way into our dwellings, whether from the mountain-side or the crowded street, is liable at once to certain

great changes. It becomes impoverished because it is quickly robbed of its oxygen; it becomes contaminated because into it are poured carbonic acid gas and many poisonous materials. Hence it may be described as 'damaged air.' These changes are due to many influences associated with indoor life.

Combustion.

All processes of combustion spoil the air. Open fires, coke stoves, coal-gas, candles, lamps, every method of heating and lighting, excepting that of electricity, deprives the air of oxygen, and adds to it such poisonous products as carbon and sulphur. In better-class houses the chief injury to air from combustion processes is due to excessive gas-burning; in the dwellings of the poor to smoky chimneys.

Walls, floors, and furniture all contribute dust, animal and vegetable débris, and impurities of many kinds to the air around, especially where houses are old, dirty, and overcrowded.

Decomposition.

Unsatisfactory arrangements for the carrying away of refuse are a great source of injury to air. Emanations from defective, ill-managed closets and sinks, dirty or disused traps, saturated woodwork, accumulations of kitchen rubbish, all have an influence on the air of the house.

Domestic animals—dogs, cats, and birds—so often kept in living rooms, rob the air of oxygen, and pour into it the poisonous products of their own life-processes.

Human influence.

But the chief cause of damage to indoor air is the influence of human life through perspiration and respiration.

Exhalations from the skin and clothes of human beings pollute surrounding air. From multitudes of glands there is a constant escape of perspiration. A large

quantity soaks into clothing, and is given off from it by degrees, while the rest evaporates directly into the atmosphere. Of course, the extent of injury to air from this source depends on personal habits; but even those who wash the skin daily, and often change and purify their garments, are obliged by the very laws of life to aid in the pollution of their surroundings.

By respiration air is both impoverished and contaminated. Every breath we take robs inhaled air of about 5 per cent. of its oxygen; every act of expiration adds to it some 5 per cent. of extra carbonic acid gas, together with other poisonous materials, which are the natural results of life.

The very object of respiration is to purify the body. The blood when it visits the lungs does so for the express purpose of obtaining oxygen and getting rid of rubbish before it passes on its journey. Through the influence of the air which it meets it is, so to speak, 'washed,' purified, and cooled, and, in consequence, the air itself both loses good and gains harm.

If we take 10,000 parts of fresh air and compare it with the same quantity of breathed air, the change in composition would be thus expressed:

Inspired Air.		*Expired Air.*	
Oxygen - -	2,096 parts	Oxygen - -	1,692 parts
Nitrogen - -	7,900 ,,	Nitrogen - -	7,900 ,,
Carbonic acid -	4 ,,	Carbonic acid -	408 ,,
Total -	10,000 parts	Total -	10,000 parts

But this table does not represent the whole of the damage done. Besides the diminished oxygen and the increased carbonic acid, there is added to air by breathing a quantity of decaying organic matter, held in solution in

water-vapour. This decaying organic matter is spoken of as *dead*, but it is only dead so far as its work in the body is concerned, and it goes on dying and decaying in the air around. It has been described as 'air sewage,' and it leaves the lungs chiefly in the form of steam, containing dead cells from the mucous membrane, a waste product of life known as 'urea,' and other impurities, varying according to the health and habits of the individual. This steam can be seen condensing on the window-glass of a stuffy room or crowded railway-carriage. Its foul character is shown by the way in which it renders pure water offensive, or discolours Condy's fluid, or taints milk and other food. It is this material in pre-breathed air that gives to crowded rooms their fœtid odour; it is heavy, and clings to walls, or condenses on furniture, giving it a sticky feeling and horrid smell. It is easily absorbed by wool, feathers, damp walls, thick rough paper, and any porous, uneven surfaces, and it is always worst and most recognisable where people are uncleanly in regard to the care of skin and teeth.

Now, nothing is better known in these days than that the solid, liquid, and gaseous materials given off from the human body must poison and kill if kept about a dwelling. Every effort is made by drainage arrangements to carry away some of these to a safe distance. In exactly the same way the decomposable material thrown off from skin and lungs into the surrounding air *must be removed* from the vicinity of the body. It is as dangerous to keep impure pre-breathed air about a room as it is to store sewage in obscure corners or under beds. It is as unreasonable to take dirty air into the lungs as it would be to go to the sewer for drinking-water.

Effects of pre-breathed air on health.

The effects on health of re-breathing expired air are worthy of careful note. Certain of its constituents are powerful nerve-poisons; hence, infants kept in close rooms are peculiarly liable to convulsions, and older people suffer from neuralgia, headache, and mental irritability. It injures the circulation, and hence we get complaints of clammy cold feet and hands in close rooms. Exhaustion, too, is produced by the poison. We all know how tiring is any kind of crowd, or how fatigued and ill people look after an evening's entertainment in a close room. The leaden-gray hue on the faces of those who have travelled in closed railway carriages or have sat in crowded buildings is a sign of the effects of air-poisons on arteries and veins.

All these and many other results might be instanced as showing the injurious effects of oxygen starvation and poison-laden air. After prolonged exposure to the danger more lasting and serious effects are seen. People who live in a close atmosphere become very liable to catch cold, are quickly overcome by infectious illness, lose strength, vitality, and resisting power.

One punishment seems to have been specially reserved for those who are careless about the air they breathe.

Consumption, or, more accurately, lung tuberculosis, is a disease of indoor existence, associated both amongst the lower animals and ourselves with life in crowded, confined conditions. By the breathing of poisonous air the body is prepared for the attacks of this terrible foe in the most perfect manner possible, while the microbe itself multiplies at an incomprehensible rate in breath-laden atmosphere.

Thirty years ago consumption used to kill 8 out of every 1,000 of our soldiers annually; now, since better

ventilation and less crowding of sleeping-rooms has been enforced, the death-rate from this disease in the British army is only 2 per 1,000 annually.

Disease-germs are omnipresent. They are certain to find their way into our dwellings, especially so long as men spit anywhere and everywhere, and women wear dresses which touch the ground. But in a well-ventilated house such germs are very likely to die of starvation or be killed by the germ-destroying oxygen, while in a close, warm room, where they can feed on the organic débris of the inmates, they remain and multiply, to be a constant source of danger.

What can be done to prevent this exceeding risk of indoor life? How can the air of a dwelling be managed so that it may be kept fit to breathe?

The first point we need to be clear about is *how much impurity can be safely permitted*, for it stands to reason that with every care we can never have indoor air as perfectly pure as that which is without.

The standard of impurity.

The calculation of the amount of real danger present—viz., the decaying organic matter—is exceedingly difficult. But it is found to vary in exact accordance with the amount of carbonic acid gas—that is to say, an increase of carbonic acid goes along with, and is proportional to, an increase of organic impurity. As it is quite easy to calculate the amount of CO_2 present, and as the relative proportions are so constant, the CO_2 is taken as a convenient measurement of air impurities.

In ordinary outdoor air, as we have seen, the proportion of carbonic acid present is as 4 parts to 10,000. By careful investigation it has been found than an extra 2 parts of this gas can be safely borne. But after this

standard has been reached air begins to be dangerous, because the waste materials represented by the increase of carbonic acid are too largely present to be breathed without harm. Thus it is that 6 parts per 10,000 of carbonic acid is spoken of as the 'standard of impurity.'

Tests of air.

Directly this point is reached, a person *coming in from the open air* can detect a certain smell of closeness and stuffiness; beyond this point, as it gets worse and the impurities increase, the smell *on first entering* from fresh air is sickening and overpowering. This is one way—in fact, the only simple way—of testing the air of a room, to go out of doors for a quarter of an hour, or even less, and then, on re-entering, notice if there is any perceptible smell. There should be no sensible difference between the air of an inhabited space and the external air if the first is fresh and wholesome.

Another simple, though rough, test of air is to take an ounce glass bottle, clean it and dry it, and then with a pair of bellows first draw out the air in the bottle, and then pump in some from the room. A little freshly prepared lime-water should then be poured into the bottle and shaken up; if no cloudiness appear, and the lime-water remains clear, the air is fit for use; if the lime-water becomes milky in appearance* we know that too much carbonic acid gas is present, and that the danger-point has been reached.

The question, therefore, that confronts the house-manager is, How can air impurities be kept down to the safe standard of impurity? How can we prevent the accumulation of carbonic acid in the air of an occupied

* The cloudy appearance will be due to the union of carbonic acid gas with lime and the consequent formation of chalk.

room beyond the permissible amount of 6 parts per 10,000?

The answer seems simple enough: The air in the room must be sufficiently changed, diluted, and moved by supplies of fresh air from without. Theoretically, this sounds easy; practically, as everybody knows, it is often exceedingly difficult. In such a climate as that of the British Isles there is one thing which the majority of people *cannot* bear, and which for all people is at times a risk—that is, *a draught.*

Ventilation.

Ventilation is the art of changing and moving the air in a closed space without causing a draught. By a 'draught' we understand the sensation experienced in a closed space when incoming air strikes upon the body, producing chilliness and discomfort. How far we feel it depends somewhat upon our own state of health at the time, but chiefly upon the temperature, rate of movement, and humidity of the air. Hence it is comparatively easy to avoid draughts and yet ventilate a house on still, dry days in summer, when the air that enters is heated to a point which makes us unconscious of its movements. But the dwelling must be ventilated in winter as well as in summer, in wet weather as well as dry, by night as well as by day, and draughts *must always be avoided*, so we must seek to solve the problem for all occasions.

Two conditions are wanted in order to insure sufficient change of indoor air without draughts. First, we must have sufficient cubic space for each person; secondly, there must be adequate arrangements for the slow admission and escape of air at suitable places round the room.

Cubic space.

First, in regard to cubic space, by which is to be understood the air-space round and

above an individual. It is very clear that the smaller the room the more difficult to admit fresh air unconsciously. A person could be kept alive in a box provided there were a sufficient number of air-holes; but then he would be killed by the draught. The less cubic space per individual, the more difficult it is to ventilate, and below a certain size the regular ventilation of a room becomes impossible.

Cubic space is found by multiplying together length, breadth, and height. Thus, if a room be 14 feet long, 12 feet wide, and 10 feet high, we find its cubic capacity or air space to be $14 \times 12 \times 10$: equal to 1,680 cubic feet.

If two people are to occupy such an apartment, we have only to divide the total cubic space by 2, and we ascertain that they each have 840 cubic feet of air space.

The question of the necessary amount of cubic space required has received the careful consideration of experts.

Into their calculations we need not enter. It is sufficient for ordinary purposes to know that 3,000 cubic feet of fresh air are required by each person every hour. In order to get this without draughts it is estimated that at least one-third of the amount—namely, 1,000 cubic feet—should be allowed per head as initial air space. That is to say, if a person can start with the amount of air space contained in a room 10 feet long, 10 feet broad, and 10 feet high, it would be possible by ventilation to keep air impurities down to the proper standard of safety.

These figures only apply to people in health.

The impurities in a sick chamber are increased in amount and are more serious in nature, and in hospitals and sick-rooms 1,200 cubic feet of air space per head is considered necessary.

Floor space.

Out of the cubic space a certain proportion must be *floor space*, or *elbow-room*.

The area of a room is of much more consequence than its height. Loftiness and airiness are not synonymous terms. We may have a very lofty room and get the amount of air space required in actual figures, while all the time the occupants may be crowded together and become faint and ill for lack of floor space. It is want of elbow-room, or *space round the body*, that causes people to faint in a crowd out of doors, or to feel ill in churches and lofty buildings where there is an immense space above them. More than 10 or 12 feet in height is of little use for maintaining air purity, unless there is artificial ventilation, because the carbonic acid gas and other poisonous exhalations from lungs and skin are heavy, and even if they rise at first when warm, they descend again and accumulate in the lower parts of a room.

From the health aspect, a good height for an ordinary apartment is 10 or 12 feet, and it is a safe rule to make the area of the floor space not less than one-tenth or one-twelfth of the cubic space. Thus, supposing we have a room of 2,100 cubic feet, the floor space ought to be 210 square feet (15 feet long and 14 feet broad), while the height is 10 feet.

Measurement of cubic space.

If a room is circular or of any irregular shape, it is necessary to find out the cubic capacity by certain special rules.

But under ordinary circumstances, in the usual case of oblong or square apartments with flat ceilings, it is only necessary to multiply length, breadth, and height together as already noticed. Any height above 10 or 12 feet may be disregarded in the calculations, unless they are mechanical arrangements for artificial ventilation,

such as a fan working in the roof to extract foul air. If there are any large projections or solid pieces of furniture, their length, breadth, and height must be multiplied together in the same way, and the space they are found to occupy must be deducted from the total amount available for the inmates. It is a chief argument against solid, cumbrous furniture that each article robs the inhabitants of so much air space. *No two portions of matter can occupy the same space.* When calculating air space in bedrooms, a bed and bedding may be set down as taking up 10 cubic feet, and this must be deducted from the whole.

If domestic animals are kept in the room, some allowance must be made for the air each will use, and if the lighting is by coal-gas there must either be definite arrangements for extra ventilation, or else 100 or 150 cubic feet of space must be deducted for each burner.

Finally, after all the subtractions have been made, we can divide the air space left between the number of occupants, and thus arrive at what each has at his disposal.

This *ought not* to be less than 1,000 cubic feet, but as a matter of practice in everyday life very few people get half this amount.

In prisons the allowance is 1,000 cubic feet per head ; in barracks, 600 cubic feet ; in common lodging-houses, 300 or 350 cubic feet is required per individual ; while in schools under the Education Department each scholar is allowed 80 cubic feet, out of which 8 square feet must be floor space. The Canadian schools, as a contrast, give 240 cubic feet per scholar. In hospitals 1,200 cubic feet, or, as at St. Thomas's Hospital, 1,800 cubic feet, is considered necessary, with a floor space of 112 square feet.

In our own homes, where arrangements are under our own control, we should endeavour to make 800 cubic feet the minimum for each person, allowing 10 feet out of this for height, so that there will be sufficient floor space.

When less than this is available, however good the regular ventilation may be, it will be absolutely essential to get frequent *complete* change of the whole air of the apartment by clearing the room of its occupants or protecting by screens while doors and windows are put wide open for a few minutes real 'wind-sweeping.'

Over-crowding.

If an apology for so many simple details, and so much repetition in regard to cubic space and its measurements is needed, let it be remembered that there are numbers of well-educated people who know nothing whatever of this subject, and perfectly ignore the question in their household arrangements. When they apportion their bedrooms, the amount of air space per individual never enters into their consideration, draughts will, of course, be shunned, and in consequence there is bound to be overcrowding and bad air. Overcrowding means insufficiency of air space per head. It is generally spoken of as a condition associated with life in tenement dwellings and slums, and as if it were found only amongst the distressingly poor.

But there is abundance of disgraceful overcrowding to be found in a very different class of residence: in the night nurseries, servants' bedrooms, and many other apartments of the well-to-do, where the roughest measurements would show an extraordinary insufficiency of air space together with—in numbers of cases—absolute neglect of ventilation.

Ventilation.

The second essential to the maintenance of a safe standard in indoor air is ventilation. However much cubic space may be allowed it is absolutely essential that there shall also be definite and continual change of air.

The size of rooms is often made an excuse for non-ventilation, and hence the horrible stuffy *large* apartments so often met with in the houses of the rich. Supposing one person occupies a room large enough to give him 3,000 cubic feet of air space all to himself; the air will be *unfit to breathe in one hour.* If, instead, it were 1,000 cubic feet at his disposal, he would have completely spoilt it in twenty minutes. Professor Corfield once made the striking calculation that for an individual to sleep in an unventilated bedroom for seven hours, the size ought to be 70 feet long, 30 feet broad, and 10 feet high; and even then at the end of seven hours the air would need complete change.

There are two general methods of ventilation: natural 1 and artificial. 2

By artificial ventilation is meant the use of some mechanical means for changing the air, some apparatus, such as fans, for driving air into the room (propulsion), or for drawing it out (extraction).

Natural ventilation.

When no mechanical means are in use the ventilation is said to be 'natural,' because whatever plans are devised we always trust to the natural tendency of the air to move, and do not force it in any way.

The essentials to natural ventilation are an inlet and an outlet. *There must be both;* one opening is not sufficient, for air can no more go in and out of the same aperture than water can.

'I keep my chimney register open' is a common argument urged to prove that everything necessary is done to ventilate a bedroom. But the open chimney will only provide an inlet *or* an outlet—never both; air cannot possibly pass up and down the one shaft at the same time. Besides, air takes up space, and if a chamber is full of air no more can enter until there is an opening for the escape of some already present. So we must have a place of admission and a place of exit if we want to change the air in a room.

Some rules about inlets and outlets are very important.

Inlets. *Inlets must admit air from a pure, unused source.* The door of a room is not a good inlet, because, as a rule, it only admits air which has been already spoiled in other parts of the house. A window which opens near a drain ventilator, or closet, or a dirty or disused gully, or the neighbourhood of a rubbish-heap, could not be said to be a good inlet. It would be safer to keep such a window closed, and have some other inlet in another part of the wall.

The air must not be admitted too quickly, or it will cause chill and discomfort. One large inlet is often a cause of draught, and answers better if it is split up into several smaller openings.

The air must be distributed over the whole room. We do not want to change the air in one part while some corners or recesses are left stuffy and unaffected. Hence, two or three small inlets in different parts of a room are often better than one large aperture, and they are best if placed in the corners of rooms farthest from doors and fireplaces.

The air admitted should be sufficient for the number of inmates. The combined areas of all the inlets in a room should, to be accurate, amount to 24 square inches for

each person. Supposing an open window is our inlet, and the length and breadth of the opening is 24 inches by 3 inches; then we get 72 square inches as the area of the inlet, and this is enough for three persons, provided the initial cubic space per head is sufficient. But if a fourth person comes in to share the room, the window should be pushed open another inch to secure the extra inlet ventilation.

It is easy to ascertain if the air inlets in a room are sufficient by holding a candle flame or taper to the key-hole. If the flame blows across towards the room instead of burning steadily and straight, it shows that the inlets are insufficient for the needs of the occupants, and that the air is being drawn in from outside, perhaps from unwholesome sources.

The *position* of an inlet should be about 5 or 6 feet from the floor, and its *shape* should be arranged so as to direct the incoming air upwards. If cold air coming into a room falls down at once upon the heads of the occupants, draughts and chilliness will be felt. If the jet of incoming air is directed upwards, it becomes warmed in the upper part of the room, and diffuses slowly and imperceptibly throughout. A good example of this is a venetian blind drawn over an open window with the laths turned upwards.

There must be definitely planned inlets at convenient places, and we must never trust to chance openings. We do not want air to enter a room accidentally, at any odd crack or crevice where draughts are sure to be felt. People often talk of their accidental ventilation through badly fitting windows or doors or floor-boards, and argue that by such means they get plenty of fresh air. But such chance inlets are sure to give rise to discomfort and chill when

the wind is in that direction, while at other times they may not act at all, and the room will be stuffy. It is far better to have such sources closed as far as possible, and to put in definite air inlets at convenient spots. In ordinarily built houses draughts nearly always enter by the door. A cold stream of air gets through the crack at the bottom and rushes across the floor to the fireplace, people's feet being in consequence in a perpetual cold air-bath. This is bad, especially for the young and aged, with whom circulation is often a difficulty and who quickly suffer from cold extremities. The only remedy is to provide a proper air inlet in another part of the room, and to close the one under the door by a thick mat outside, or rubber edging, or some such device.

A screen is invaluable as a help towards the management of ventilation, especially where cubic space is insufficient and draughts uncontrollable. A folding screen reaching quite to the ground should be regarded as an indispensable article of furniture in most rooms. When a fire is burning in the grate, incoming air always tends to move towards the chimney, hence the draught of which we often complain when sitting before a fire or between the window and the grate. A screen breaks such an air-current, and shelters from draught. It can be put round a bed or arm-chair or sofa, and will act like a breakwater in making sheltered spots which can yet be well ventilated. A screen round a bed at night makes an open window possible under the most difficult of circumstances.

In fogs, incoming air can be filtered and dried by stretching a piece of muslin across the inlet. Muslin or lace curtains drawn over an open window act thus as a valuable means of cleaning the air.

Devices for inlets.

All sorts of plans for the admission of air have been devised.

An open window is the best inlet where it is possible to make use of it. By opening top and bottom we get both an inlet and outlet, though, perhaps, not altogether of the most approved kind. A light curtain drawn across at night will break the current, and direct incoming air to each or one side.

An open window behind venetian blinds with their laths turned upwards makes an excellent inlet at night.

Another familiar expedient is to place a piece of wood or plate glass of exactly the width of the window, and 3 or 4 inches deep, under the bottom sash; when the window is closed air enters upwards between the two sashes. This device is known as the Hinckes-Bird ventilator.

The upper segment of a window can be made to work on a hinge, so as to open into the room and form an air inlet.

A pane of glass in the window can be replaced by a piece of perforated zinc or wire gauze. This makes an admirable air inlet for a larder.

Windows can be fitted with louvred panes or circular glass ventilators, but these should not be put in too high up.

In exposed positions the inlet may be arranged by having double windows, and keeping open the bottom of the outer and the top of the inner one.

Apart from window arrangements, there are many inlet ventilators in the market.

Ellison's air-bricks, with their conical holes which expand towards the room, can be put into an outer wall at suitable places, and make good and cheap inlets allowing for a satisfactory distribution of the incoming air.

Sherringham valves and Tobins tubes are both forms of inlet ventilators frequently adopted, but they have the disadvantage of being closed or stuffed up at will. The most successful ventilators are those which do not depend upon the feeling or memory of the inmates for their action, and which cannot be easily closed.

A simple and inexpensive little plan is to insert the bent arm ('easy bend') of a drain-pipe, 4 inches in diameter, somewhere in the outer wall, about 6 or 7 feet from the floor. A grating is placed over the opening on the outside, and the bent shape allows of the air entering upwards and flowing along the upper part of the room before it falls on the heads of the occupants. The piece of pipe must not be fixed too close to a ceiling, or just under an overhanging shelf, as the air may be driven down with unpleasant force.

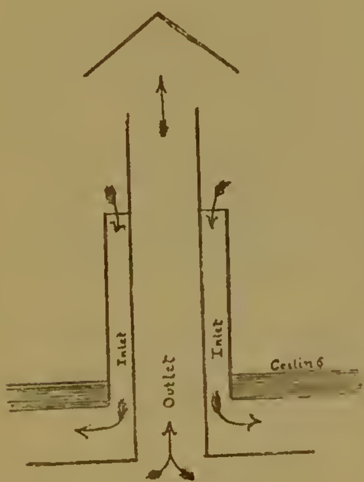

FIG. 1.—MC'KINNELL'S VENTILATOR.

In upper rooms or attics, especially where there is no fireplace, or where the window cannot be used or there is only a skylight, a Mc'Kinnell's ventilator is a very useful arrangement, as it combines both inlet and outlet. It consists of two tubes or shafts, one within the other, let into the ceiling or roof. The inner tube, which acts as the outlet, is carried up higher than the other, and is fitted with a cowl. The lower end of the inner shaft is continued into the room a little way, and has a rim

which extends along level with the ceiling, so that air entering flows in the direction of the warm air in the upper part of the room.

All inlet ventilators, even open windows, depend for their action upon the way of the wind. If they are to leeward, very little air will enter except by diffusion, while when the wind blows in that direction there may seem to be too much air movement in their vicinity. In cold weather the results are more likely to be satisfactory than in summer, because, as already noticed, the movement of the air in and out of a house depends greatly on the difference in temperature. A small inlet in winter will very likely be more effective in purifying a room than a larger opening in summer.

Nothing assists the action of an inlet like warmth in a room, and it is this which makes the open fire, with all its disadvantages, of great value from the ventilation point of view. A colder body of air always moves in the direction of a warmer one, and with a speed depending upon the relative difference of their temperatures. Thus, a fire helps inlet ventilation by dragging air in through every available opening, and so keeping up air movements.

If fresh air is warmed before it enters the room much more can be borne, and when there is insufficient cubic space this is often the only way by which we can get over the difficulties of ventilation without draughts. Sir Douglas Galton devised the grate which bears his name for this very purpose. At the back of the fireplace is an opening to the outer air, protected by a grating, through which fresh air passes into a shaft which runs up by the side of the chimney flue. In the shaft it becomes warmed by the heat which escapes up the chimney, and

this warmed fresh air is admitted into the room through a grating near the ceiling.

Outlets. One outlet in an ordinary room is generally sufficient. It should be placed as far as possible from inlets and on the opposite side of the wall, only not immediately opposite. If inlets and outlets are just opposite each other there is a risk of what is called short-circuiting, the air rushing directly from one to the other, purifying one part of the room and leaving the rest unaffected.

Various outlets have been devised to carry off foul air from an apartment.

The open chimney answers well; when a fire is burning in the grate an ordinary fireplace extracts air at the rate of 4 or 5 feet per second. When the inconvenience of down-draughts and smoke are experienced it is frequently a sign that the inlet is insufficient. Everyone has noticed how often the opening of a window will stop a fire smoking, the fire burning badly only for lack of air supply.

The value of a chimney as an outlet-ventilator depends on the aspirating or drawing influence of the wind as it passes over the top, and produces movements of air in the shaft. But on a still day, when there is no fire burning, the air is apt to become motionless in the chimney, and there is no extracting or ventilating influence at work. For this reason, especially in a sick-room, a fire, however small, or even a lamp burning in the grate, is a great assistance to air purification, as air movements are started by the warmth, and the chimney becomes an outlet for foul air. The cleaner a chimney the better its ventilating capacity.

An additional outlet may be secured by having a valve

ventilator, such as Arnott's or Boyle's, put into the chimney breast. Bad air escapes through this into the chimney, while the mica flap valve within, swinging one way only, prevents smoke from entering the room. These outlets connected with a chimney lessen the chance of draught round the fireplace; their only disadvantage is that they do not conform to the important rule that all ventilating openings—even outlets—should communicate direct with the open air.

Sometimes an outlet is formed by placing a shaft or tube in the ceiling, leading from the centre, and hidden from sight by some decorative moulding.

If shafts are used, they should be as short as possible, of circular shape, made of metal, and without any angles or bends. One right-angled bend in a ventilating shaft diminishes its ventilating capacity by one half. Many outlet shafts have been devised, and their efficiency greatly increased by movable cowls, which prevent down-draughts and help air movement in the shaft.

Sunlight gas-burners are excellent contrivances for outlet ventilation. The gas-jets are connected with a shaft passing out through the ceiling, and the heat generated acts as an extracting influence upon air impurities, and carries them away from the room.

The upper part of an open window seems a very natural outlet for stale air, but when the window has also to answer the purpose of an inlet the arrangement is not satisfactory, because both openings will be on the same side of the room and too near one another to allow of much of the inside air being affected.

All ventilating gratings and pipes should be accessible for cleansing, and *should be kept clean.* Dust, dirt, cob-

webs, and soot mean friction, and friction interferes with ventilation.

After all the various methods for securing natural ventilation have been considered, we must come to the conclusion that where it is practicable there is no better plan in ordinary rooms, with sufficient cubic space, than to use open windows for inlets and chimneys for outlets.

The open window has a distinct moral as well as physical advantage. It is good for people *to see that there is something open*, to be educated to the belief that it is unnatural to be shut up in a box. All other devices should be regarded as useful *extra* plans, to be resorted to when these natural methods are unavailable or insufficient. Living and sleeping with open windows is largely a matter of habit. Those who have become accustomed to it find themselves utterly unable to go back to closed rooms, and this is strikingly seen in the case of people suffering from consumption who have become educated in sanatoria to want plenty of fresh air. Numbers of experiments in schools and other institutions have proved that open windows can be borne day and night in the coldest weather with the greatest advantage to health, provided individuals are protected by good feeding and woollen clothing.

Artificial ventilation.

Of artificial ventilation it is not necessary to speak at great length. There are many occasions, as in schools, hotels, hospitals, and theatres, when it is impossible to avoid overcrowding at times, and impossible to get enough change of air without mechanical assistance. There are two systems—that known as propulsion, or plenum, and that known as extraction. Authorities differ widely as to which method is the most satisfactory.

By propulsion fresh air is 'pushed forward,' or forced into the building by revolving fans or pumps, or some other means. The air is warmed by passing it over hot-water pipes or some heating apparatus, and thus a great quantity can be admitted rapidly without risk or discomfort. Often, too, the driven air is cleaned by passing it through screens of cotton wool or fibre, or over water. Generally the air is driven into a basement chamber, where it is heated and cleaned, and forced through pipes which open into the room, about 7 feet from the floor. The air, after mixing through the room, is finally obliged to escape by shafts opening into the roof, because of the velocity with which supplies of fresh air are being forced in from behind.

The advantage of ventilation by propulsion is the certainty and regularity with which the air can be moved and supplied, and the insurance of a good source of intake. But the method is expensive and requires constant supervision.

By extraction methods foul air is drawn out of a room by fans working in the roof, driven by some force like electricity, or by means of heated shafts, through which an up-draught acts as the extracting agent. Heat is nearly always the agent used. Mines are ventilated in this way by a furnace at the foot of an up-cast shaft, fresh air being drawn in through another shaft. In the Houses of Parliament the furnace in the basement of the clock-tower extracts the vitiated air through a shaft which communicates with the chamber. Fresh air is allowed to flow in through pipes in the basement, and in its passage it is cleaned through screens of moistened canvas and warmed over hot pipes. In prisons, by Jebb's system, fresh warmed air is supplied at openings near

the ceilings, and sucked out at the floor-level, fires being kept burning in the roof and basement to create a powerful extraction draught.

Extraction seems the more simple and the least expensive method; but it only deals with foul air, and fresh air is left to find its way in, sometimes from impure and unsatisfactory sources of supply.

A gas-jet burning under a shaft which passes up through the roof would be a simple method of extracting air from an attic or room in which no ordinary outlet was available.

Cowls are generally put at the top of extraction-shafts, and great improvements have been made in these lately through the efforts of the British Sanitary Institute.

For ordinary dwellings, natural ventilation, if thoughtfully and intelligently managed, should be sufficient, and is far more bracing and healthy than artificial methods. The body has its own apparatus for cleaning, warming, and moistening the air, and it is more natural to breathe *unprepared air*. But even in dwelling-houses there are circumstances which may make extra means essential. Natural ventilation ceases to be sufficient when—

(*a*) Cubic and floor space are below the necessary amount;

(*b*) When inlets and outlets cannot be properly arranged;

(*c*) When there are unavoidable down draughts, cross draughts, cold floor currents, and uneven distribution of air.

Flushing, or wind-sweeping.

There is yet one more essential to the proper management of indoor air.

Besides sufficient cubic space per head, besides definite arrangements for constant imperceptible

change of air, there is yet one more duty devolving on the house-manager, which *must* be discharged if the house is to be kept fresh and wholesome,—there must be occasional *flushing*, or *entire change of air*.

No amount of cubic space, no system of ventilation, however perfect, can ever do away with the necessity of *wind-sweeping*. Early in the morning, before and after meals, the last thing at night, and on occasions when many people have been gathered together, doors and windows must be put wide open, and a few minutes 'flushing' with fresh air must take place. It is only by such wind-sweeping of our rooms that we can clear away solid and heavy impurities, and bad air that lurks in corners, and recesses, and about the floor-level.

Occasional and complete change is often all the air-purification possible in the small crowded dwellings of the poor. It is one of the most urgent duties of a district nurse, or any health-messenger to such homes, to see that at least one good wind-sweeping of the apartment takes place during her visit. Of course, it must be done gently, with consideration, explanation, and precaution. We cannot expect the ill-clad and poorly-fed to like fresh air. 'It takes years of good feeding to stand an open window,' was the remark of a poor woman who had been urged to commence better airing of her house, and she was right. Nevertheless, we are bound to admit the fresh air for them whenever we have opportunity; we are bound to try and clear away their air-refuse as much as we remove any other sort of filth that we discover. The sick must be covered up or sheltered by screens, the healthy can be cajoled to leave the room for a minute or two, while everything is put wide open, and the out-door air is allowed to do its purifying work.

Where ventilation is perfect, we must still take care to have the occasional *complete* change of air; where ventilation is imperfect and overcrowding is inevitable, we must seize every opportunity for wind-sweeping, even if it be only for half a minute.

It must be borne in mind that *extra* ventilation is needed when people are engaged in active work. During such exertions as singing, dancing, scrubbing, sweeping, more air is spoiled by the individual, and therefore more is required. When deep breaths are unavoidable and more air is passing in and out of the lungs, it is obvious that there is greater risk to personal health if the air inhaled is damaged and poor.

Finally, as we think of Nature's wonderful lessons and the marvellous system of air-purification which works so perfectly out of doors, we must not forget that sunlight and plant life are both agents which we can call to our assistance indoors. Sunlight will help by its warming influence to start air movements, and by its marvellous disinfecting power will help to free our dwellings of malignant microbes.

Plants indoors in the daytime are healthful air-purifying agents; but it must be remembered that their chlorophyl grains only act on carbon dioxide in the presence of sunlight, and that at night they are simply using oxygen like ourselves, hence they should not be kept in sleeping rooms.

CHAPTER VI

THE WARMING AND LIGHTING OF THE DWELLING

Many strange notions prevail as to the value of external means of warmth. It will be wise to remind ourselves of some physiological facts before proceeding to notice the domestic aspect of the question. Human beings possess the power of keeping themselves warm from within. We are not warmed by our fires, or hot-water pipes, or clothes, but by operations taking place within our own bodies, which give rise to the evolution of heat. And no matter how cold or how hot our surroundings, the temperature of the body in health remains somewhere between 98° and 99° F.

Food combustion.

The source of this internal heat is the combustion of food. The burning process is kept up by supplies of oxygen from air and combustible materials from food. The better these supplies, provided the body is working rightly, the better burns the internal fire. Neither supply is of any use alone. Oxygen makes burning possible, but food furnishes material to be burnt, so both are needed.

Some foods we know burn better than others and give off more heat—such, for example, as all sorts of fats and sugars, and in cold weather a larger quantity of these is

needed. Hence the first condition of keeping warm is to have good supplies of oxygen and plenty of combustible foods.

Woollen clothing.

Another valuable assistance to the maintenance of body-warmth is the wearing of some material next to the skin which is a bad conductor. Wool is the best example of such materials, and by means of its non-conducting properties the body is protected from injury by heat or cold from without, and guarded from an unnecessary loss of warmth from within. People who object to woollen clothing would be surprised at how much such material prevents them from feeling the cold, and how much less dependent it enables them to be of fires and other artificial means of heating.

These facts about the true source of animal heat and the protective influence of woollen clothing need frequent emphasis. Considerations of air, food, and clothing must precede all questions of artificial warming. The managers of a school had before them on one occasion the question of the better warming of the school buildings. Someone proposed that before spending more money on hot-water pipes and extra stoves the experiment should be tried of providing each scholar with a cup of hot milk, or cocoa and milk, in the middle of the morning. The effort proved a wonderful success; there was better work done and greater comfort in doing it, for the simple fact that the children, who were martyrs to chilblains and shivered with cold, were suffering far more from lack of a good breakfast, or a night's sleep in oxygen-laden air, than from any need of larger fires.

But despite air, food, and woollen clothing, we find some artificial warming of a house essential during a part

of the year, the need increasing as we are farther removed from the tropical regions of the earth's surface.

Both warming and lighting are closely connected with the question of air management; in artificial methods of ventilation they are often worked together. But it is probably far wiser in ordinary dwellings to keep arrangements for heating and lighting quite separate from those for ventilation.

Warming. *The temperature throughout a house should be as even as possible.* Sudden changes from a hot sitting-room to cold passages are often a cause of chill. An open fire, or a stove (with proper flue), or an oil stove burning in the hall, or on the landing of a house, not only helps to ventilate by starting air movements, but prevents any great difference of temperature between the body of the house and the rooms.

Hot-water pipes are often adopted throughout the dwelling to insure equal heating.

We should particularly *avoid overheating.* Not only does too high a temperature indoors enervate and enfeeble the inmates, but it acts as a powerful suction-pump on traps, pipe-joints, and drainage appliances, often starting dangerous places which before did not exist. In living rooms a temperature of 55° or 60° F. is quite sufficient for ordinary circumstances.

For very young children, or aged people, or in some illnesses where there is much exhaustion, a room may have to be kept warmer, at 60° or 65° F. But in sleeping rooms the temperature may drop to a far lower level without the least risk of harm.

Feelings are no guide to temperature; a thermometer is an indispensable article of furniture in every room if we are to avoid either overheating, chilliness, or varia-

bility. People sitting continually in a room with a large fire and several gas-burners are often quite unconscious of a temperature that is perhaps 70° or 80° F.; whereas, on the other hand, if there is no thermometer to guide us, living-rooms in which people are engaged in sedentary occupations, especially those occupied by children, are apt to become too cold, and bodily strength and working power are diminished in consequence.

The best way of warming a house is by means of the sun's rays, and all that is available of this natural supply of heat should be obtained. The spring and early summer sunshine is especially valuable for the warming up of the walls and interior of the house after winter cold and darkness, and sun-blinds should be postponed as long as possible.

The principal methods of artificial warming are open fires, stoves of various kinds, hot-air and hot-water pipes.

The open fire, which warms, as the sun does, by radiant heat, is the most usual method in England, and has many advantages. It is cheerful, companionable, and a very valuable help towards the air purification and ventilation of the room. But there is dust, smoke, and trouble to be considered; much waste takes place, as only 13 per cent. of the resultant heat finds its way into the room. The warmth is very unequally distributed, parts of the room remote from the fire being quite unaffected, while other parts become too hot.

Many of these disadvantages are avoided by good construction. As much fire-brick should be used as possible; the back and sides should be all of fire-brick. The throat of the chimney should be small. The back should slope forward towards the room. The bottom

of the grate should be deep from front to back. The bars in front should be narrow, and the space beneath the fire should be closed by a well-fitting iron 'economizer,' to keep out cold and insure better combustion.

Smoky chimneys should always receive immediate attention, as the components of coal smoke are prejudicial to health. Generally a smoky chimney shows want of ventilation in a room, just as 'dry rot' in boards shows lack of ventilation underneath. But often a chimney smokes from bad construction, through not being carried up high enough, or for want of a cowl, or from the need of sweeping; no kinder act can be done for those who either cannot help themselves, or who have grown accustomed to put up with any misery, than to get such conditions rectified. It is horrible to think of the atmosphere of smoke and soot which so often pervades the dwellings of the poor, and of the harm done to breathing organs and general health by this wholly avoidable danger.

Stoves are often objectionable. Their ventilating power is much less than that of an open fire. If made of cast-iron they are liable to emit a disagreeable smell and to injure the air by the giving off of carbon monoxide, a very poisonous gas. They also make the surrounding air hot and dry. Various devices are in use for avoiding these risks. Wrought-iron or earthenware lined with fire-clay is used in the construction of stoves; more care is taken to have well-fitting joints, and vessels of water are placed on the stoves to moisten the atmosphere. Many forms of ventilating stoves can now be obtained.

Gas fires are very cheerful-looking, economical, and clean. They are quite safe hygienically *if a chimney or flue is provided for carrying off the products of combustion.*

The best form of gas stove is that in which incandescent fragments of asbestos in an open grate are used. There are condensing stoves for sale with upright tubes through which water vapour produced is conducted to a tray beneath. This water carries down with it sulphur and other products, but, as in all gas stoves, there should be a flue communicating with the open air.

When gas stoves are fixed in fire-places, the chimney should be left entirely open for purposes of ventilation.

Oil can be used in stoves instead of gas, but a tray of water must be placed above, and great care must be taken to keep the lamp thoroughly clean, and to allow of extra ventilation.

Charcoal stoves, or any stoves without flues, are highly dangerous. Carbon monoxide, which is given off, is a deadly poison to the body, displacing the oxygen from the red corpuscles of the blood, and so inflicting severe injury.

The Galton grate, already alluded to, is an excellent method of warming a room. It not only has the advantage of the open fire, but also enables a supply of warmed fresh air to be constantly admitted.

In the Calorigen stove the air is brought in by a pipe opening either above or below the floor, which conducts it to a coil of wrought-iron tubing within the body of the stove. A gas flame, burning below the coil, warms the air before it passes out into the room, the stove itself giving out heat as it becomes warmed. The poisonous products of the gas are carried off by another pipe leading from the upper part of the stove to the open air. This is an excellent contrivance from every point of view.

Heating by means of steam or hot-water pipes is in

very general use for large buildings. The arrangements are, of course, costly, and require care; the coils of pipes should be accessible for proper dusting, and cold outside air ought to be admitted over the pipes to be warmed as it enters, so as to secure ventilation. The great risk of heating with hot-water pipes is lest inlets and outlets for ventilation shall be forgotten.

Rain-water is best for heating purposes; if hard water is used there is risk of deposit upon boilers and pipes.

All methods of warming make use of the propagation of heat by one of three means—*radiation*, *conduction*, *convection*. In *radiation*, heat rays, like light rays, are thrown off in all directions equally, and in straight lines. It is the most stimulating form of heating, and it is by radiation that an open fire warms a room. In *conduction*, heat is propagated through any solid by slowly passing from one particle to another, as in the travelling of heat along a spoon to its handle, or up the whole length of a heated poker. It is by conduction that iron pipes and the walls of stoves heat a room.

Convection is the mode by which heat travels through liquids and gases. Warmed particles expand, become lighter and rise; colder, heavier particles take their place, and so convection currents are produced. Heating by hot air and hot water is an example of the use of convection.

Artificial lighting.

We have already noticed the beneficent influence of natural light on the dwelling. Artificial lights have a very different effect. With the exception of the electric light, all methods contaminate the air and make ventilation more necessary and more difficult. They abstract oxygen from the air,

and add moisture to it, together with carbonic acid gas, soot, and many worse impurities.

Alas! too, 'lighting-up time' means in most houses 'shutting-up time.' At the very time in the day when indoor air is liable to suffer from extra contamination, we close our windows and make our rooms as air-tight as possible.

Coal-gas, oil, and candles are the most usual means employed for lighting ordinary dwellings.

Coal-gas. Coal-gas is a mixture produced by the destructive distillation of coal when it is heated in closed retorts. Its lighting power is due to the presence of compounds of carbon and hydrogen. When the gas is burnt, it not only uses oxygen and adds water-vapour to the air, but there are also other impurities given off, such as sulphurous acid, which injure plants and pictures.

Each cubic foot of gas spoils as much air per hour as one adult would do by breathing.

A common 'flat-flame' burner uses 8 or 9 cubic feet per hour, so the damage done to air by such a burner would be equal to that of four or five people. For the proper removal of the poisons given off it is reckoned that every cubic foot of gas requires 450 cubic feet of fresh air, so that at least one-third of this—namely, 150 cubic feet—must be added in our calculation of air space for each gas-burner. A 'flaring' gas-jet means more harm still, because there is not only great waste of gas, but half-burnt materials are passed into the atmosphere, and these are exceedingly bad for health. The pressure at the meter ought to be regulated to prevent any such 'flaring.'

Great improvements have taken place in gas appli-

ances of late, so that many of these disadvantages have been overcome. Incandescent gas lights, with their asbestos mantles exposed to a Bunsen flame, allow of no escape of unburnt particles, while there is far less fouling of air, together with a more brilliant light.

Better still are arrangements such as the 'Globe light,' in which the gas flame gets its air from outside, and so is no drain upon the oxygen of the room, while the products of combustion are carried off by a tube directly into the open air.

A risk to be always carefully guarded against in the use of gas is the escape of minute quantities from defective fittings. Gas leaks, especially in bedrooms, are bad for health, causing headache and sore throat, even when very slight.

Whenever gas is used for lighting, certain rules should be impressed on people's minds.

There must always be extra ventilation, or some definite arrangements, to carry off noxious products and supply the burner with outside air. Gas should never be lighted to warm a room. A gas-jet should never be left burning at night, even if it be only a glimmer. A glass or metal shield should be hung above the burner to save the deposit of soot on the ceiling, or, better still, a metal tube of zinc or iron just above the burner to carry off the heat is a great protection from any of the harmful results of gas burning. Gas-pipes should be fixed where they can be seen and leaks easily repaired. Never let a gas-jet 'flare,' and burn as little gas as possible.

Candles and lamps.

Candles, if used in the number necessary to give as much light as gas, would be even more injurious and unpleasant. As a matter of fact, we are content with much less light when employing

candles or lamps; hence these means of lighting are preferable to coal-gas.

Oil lamps should have metal reservoirs, not glass or china. They should never be overfilled, or be allowed to burn quite dry. It is exceedingly important to keep every part of a lamp perfectly clean, so that the perforations which allow of draught and air inlet are kept clear. All lamps should have a patent extinguisher. In attics, or any rooms where the ceiling slopes, a 'hurricane' lamp should be used, or some other of the same kind, which is protected above, and is self-extinguishing if upset.

CHAPTER VII

THE WATER-SUPPLY OF THE DWELLING—THE DANGER OF CONTAMINATED WATER

THERE are many reasons why the subject of water-supply should be carefully considered and understood by all housekeepers and students of health.

Man's need of water.

Everyone knows that water is one of the fundamental necessities of life. Next to air it is man's chief need. Three parts of the human body itself are nothing but water. Regular supplies of water to drink are essential to the preservation of the fluidity of the blood, to the maintenance of the uniform temperature of the body, and to the health of all the functions of life. Water dissolves food, and probably dissolves and washes away many unwholesome materials which might otherwise accumulate internally and injure health. We cannot do without water for cooking and cleansing purposes, and better regulations as to domestic water-supply must be reckoned amongst the greatest blessings of our times.

But there is a still more urgent reason for a consideration of the subject.

Water-borne diseases.

Water can be a cause of certain terrible illnesses—cholera, enteric fever, and diarrhœa. Of the first there is happily no need to speak at the present time, so far as English domestic life is

concerned; but the others are well enough known. An attack of typhoid or enteric fever is one of the most serious calamities that can befall a human being, and it is still a very common illness in this country, causing many deaths every year and wrecking a still greater number of lives. It is the duty—it must surely be the earnest longing—of everyone who has any realization of the value of health, to close every channel in a dwelling by which this repulsive and entirely preventable disease may enter, and to aid in the effort which is being made to remove all those conditions connected with our habitations which predispose and prepare for the attacks of such a foe.

Water can be a cause of damage to health in smaller ways also. The drinking of unwholesome water, if it does not bring any specific disease, yet disturbs the functions of the body, causes indigestion and diarrhœa, and thereby lowers vitality and prepares for outbursts of serious illness.

We need only consider in these pages the particular properties of water which should be understood in domestic hygiene.

Characteristics of wholesome water.

The characteristics of wholesome water should be known to everyone.

It should be colourless. Though sometimes a blue hue may be seen in chalk waters, or a yellowish tint in that from peaty districts, a reddish appearance may denote the presence of iron, or a green hue may come from the colouring matter of plants, yet, strictly speaking, water looked at in a clean glass vessel against white paper should be entirely without colour. Any yellow or brown look may be a warning of sewage contamination.

Good water should be tasteless. People talk of the palatability of water, and complain that when boiled it becomes 'flat and insipid.' But the so-called palatability is only due to atmospheric gases dissolved in the water, and any actual taste—unless from mineral substances—should make us suspicious of harm.

Wholesome water should be inodorous. If we want to be sure about this point, it is best to heat the water and notice *if there is any smell* to the steam. Any disagreeable odour should be regarded as probably denoting polluted cisterns, dirty utensils or filters, or sewage impregnation.

Good water should be transparent, bright, and free from sediment after standing, though after boiling hard water there may often be a white sediment, which is no sign of harmful properties.

It must be remembered, however, that neither one nor all of these characteristics will serve as an infallible test. Water may be sparkling, clear, and free from any perceptible smell or taste, yet it may have come from a shallow well into which some drain or cesspool is leaking. When there is the least doubt about the source of supply, it is best to have a sample analyzed and examined by both a chemist and bacteriologist, as it is only by their joint report that we are able to know of the safety of water for drinking purposes.

Hard water.

Waters are generally divided into two classes—hard and soft. The terms merely signify the difference in their behaviour towards soap.

By hard waters we understand those which require a great deal of soap in order to make a lather. Waters obtained from limestone, chalk, and oolite districts, and from deep wells sunk into the chalk, are all likely to be

hard, while rain or moorland waters are soft, and take much less soap for washing purposes.

Hardness is due to the presence of salts of lime and magnesia collected from the soil through which the water has passed. These salts are held in solution by the carbonic acid gas which has been taken up by the rain from the atmosphere. When the salts are in the form of carbonates, and able to be precipitated by boiling, the water is said to be *temporarily hard*; when they are in the form of sulphates—fixed salts of lime and magnesia—they are not much affected by boiling, and the water is said to be *permanently hard*.

The hardness of water is measured by ascertaining how much of a standard soap solution added to a certain quantity of the water is required to make a lather lasting two minutes. Thus, the water brought to Glasgow from Loch Katrine is said to have 1 degree of hardness, while another, such as some of the London water, may have from 12 to 21 degrees.

Hard water is wasteful, because very much more soap must be used for cleaning operations. It is bad for cooking operations, making vegetables hard and indigestible; and the crust that collects on the interior of kettles and boilers may cause explosions, and necessitates the use of much more heat for boiling water. Hence no one would choose to have hard water for domestic supply. With many people its continuous use not only roughens the skin, but is trying to health, causing dyspepsia, constipation, and other troubles.

Those who are generally accustomed to soft water, and are obliged in holiday times to be in districts where the water is very hard, are often much disturbed in health, and should drink aerated waters or distilled water rather

than run the risk of serious discomfort, or even illness. Boiling softens temporarily hard water, but to produce any great effect the boiling should be continued for twenty minutes or half an hour. The effect produced is that the carbonic acid present is set free by the boiling, and the salts fall to the bottom.

Carbonate of soda is often used for softening water in laundries. Water companies sometimes soften water on a large scale before delivery. Lime or lime-water is added in definite proportions; this unites with the carbonic acid to form lime carbonate, which is deposited, together with the original salts, at the bottom of the utensil. This powder left after the softening process is known as whitening, and is either sold or reburnt for use.

A little anti-calcaire, or some such preparation of lime, may be added to the water for toilette and household use, but neither the white powder left at the bottom of jugs nor the crust cleaned out of kettles must ever be thrown down drains, as it is liable to collect at the bottom of traps and interfere with their water seal.

Soft water.

Soft water is much more pleasant and economical, but may be a source of danger because of its action on new lead. Hence, where the water supplied is soft, cisterns and pipes should never be made of or mended with lead. Waters most likely to affect lead and be a cause of lead-poisoning are those obtained from the rain direct, from moorlands, or from lakes.

Quantity of water required.

Two points have to be considered in water-supply—quantity and quality.

The quantity must be sufficient and accessible for use. In London the quantity allowed per

head per day is about 28 gallons. It is generally reckoned that from 20 to 25 gallons should be allowed for each individual where there are baths and water-closets. But the amount actually used, of course, depends on the habits of the people and the condition of the place.

In towns the question of water-supply now receives careful consideration, but in country districts there is often great neglect, the inhabitants frequently having to go some distance for their supply, perhaps to streams or ponds, or some wayside pump, while the quality is often terribly unsatisfactory.

There are an immense number of statutes and regulations, but, as usual, they are ignored in many parts. According to the Public Health (London) Act, an occupied house without a proper and sufficient water-supply is 'a nuisance, and unfit for human habitation,' and no house built or rebuilt is to be occupied until a certificate has been given by the sanitary authority showing the water-supply to be satisfactory. By the Public Health Act of 1895, which applies to the country at large, the water provided must be 'pure and wholesome,' and the pressure enough to carry it 'to the highest story of the highest house.'

Quality.

The quality of water supplied is of supreme consequence, and everyone should understand something of the different sources from which it may be derived, with their relative advantages and risks.

Rain-water.

The rain-water may be collected from roofs and gutters, and stored in tubs or tanks above or below ground. In farms and country houses this source is often the only one available, and the advantages of convenience and economy are great. But

if this plan is adopted great care must be taken to insure that the roofing materials do not contaminate the water—thatch or felt, for example, being quite unsuitable. There must be proper gutters and rain-water pipes for collecting and conveying the rain, and these must be constantly cleaned and cleared. The storing tank or tub must be made of proper material. Galvanized iron, slate, or good cement concrete answer well, but there must be no bright lead about it, as the water in such a case is soft, and will act on lead. The tank must be well covered and be often cleaned, and it is far safer to have it above ground, so as to insure its being easily and often examined. In towns and suburbs rain-water, before it can be collected, has become too contaminated by dirt from the air and filthy material from roofs to make it a possible source of drinking-water supply, though for washing and other domestic purposes it is invaluable, and should more often be collected and utilized.

If ever rain-water has to be used for drinking and cooking purposes, whether in country or town, it should be effectually filtered, and if stored in any underground tank it is far safer to boil it, for fear of unsuspected contamination. A rain-water separator is often used, and by it the impurities are carried away, and only clean water allowed to flow into the storage tank.

It is impossible to think of rain as a satisfactory and reliable source of supply, because of the intermittent and uncertain character of the rainfall.

Rivers.

Rivers and streams are sometimes used as a source of water-supply for the districts through which they flow; but unless the water is taken from a point far above any possible contamination—in quite the early stages of the river—the risks of pollution are

very serious. Before 1866, when regulations were passed which prevented water being taken from below Teddington Lock, the Thames water was a constant source of danger to London, and cholera was a frequent visitor.

River-water, when supplied for domestic purposes, is generally purified by filtration through sand and gravel. All Thames water supplied to London is thus treated, and the huge filter-beds are familiar sights in many parts.

The danger or safety of river-water depends on the position of the intake, and also upon the extent to which its own self-purifying agencies are able to counteract harm.

Sunlight, oxygen, and movement are all influences which constantly purify water as well as air, while plant life, small aquatic animals, and bacteria all assist in the removal of impurities. Hence, if a river is broad, with a large surface exposed to the light and air; if it has a long enough flow to allow of the action of living agencies of purification; if, above all, it has plenty of movement over a rocky bed, with occasional waterfalls or weirs to cause agitation or aeration—then, even if there have been pollution, river-water may right itself and become fit for use.

But however great may be the self-purifying action of rivers, and however much care may be taken about filter beds, it remains a fact that people always cast into any available watercourse in the neighbourhood much rubbish or filth; and considering the terrible risk of typhoid fever from polluted water, it is a matter of common-sense to *boil* all such water if ever we have to depend on it for our drinking-supply.

Upland gathering grounds.

From lakes in barren or uncultivated highlands, and from the head-waters of rivers and streams in uplands, we get our most whole-

some and abundant water-supplies. The collecting grounds must be in the hands of the authorities and under constant supervision, as directly dwellings spring up on the area or manuring of the land takes place, we are confronted by the same risks as those mentioned in connection with rivers. It is from such upland gathering grounds that Liverpool gets the magnificent Vyrnwy supply, or Manchester from Lake Thirlmere. The moor-water is often rich in vegetable organic matter and liable to be soft, hence care is needed about fittings and storage.

Springs. Springs are sometimes used as a source of water-supply to a single dwelling or a small collection of houses. They are merely the rain-water which has sunk into the ground a certain distance, and has come to the surface again at some spot owing to the configuration of the strata. They are called surface or land springs when they appear from surface-beds of gravel; main or deep springs when found in deeper strata; and mineral springs when they yield water containing special mineral matters in solution. In hilly districts there are generally numerous springs, and when they can be used they furnish a good source of water-supply for isolated country dwellings. Many legends and superstitions are attached to particular springs, the people often having wonderful confidence in the peculiar healing properties of the water.

Wells. The commonest method of obtaining water has always been to dig for it. Wells are the most ancient source of water-supply in the world. There are two kinds—shallow or surface wells, and deep wells.

Shallow or surface wells are found in great numbers as sources of domestic water-supply to farms, isolated houses, and village districts. Thousands of people in

Great Britain depend upon the water of shallow wells. Such a well is simply a hole dug in the earth until the first store of ground-water is reached. Its depth may vary from 15 or 20 feet to 50 or 60 feet; but, generally speaking, a shallow well is one that is less than 100 feet deep, and it *always takes the first water that comes.* This water is just the rain that has percolated down a little distance through gravel or other porous soil until it came to clay, or some impervious stratum which held it up and made a sort of water-bed, known as the 'subsoil water.' If such a shallow well were situated in an uninhabited, uncultivated district the water might be safe; but shallow wells are generally found in farmyards, village streets, orchards, backyards, sometimes under sculleries or some part of the house. In such positions the water is constantly liable to pollution from the soakage of farmyards, stables, manure-heaps, or closets; but the worst danger is from the probable proximity of cesspools or drains, and the great likelihood of connection between the two. The cesspool, or 'dumb well' as it used to be called, was generally sunk somewhere near the water well, the cesspool being constructed in such a manner as purposely to allow of its contents oozing away into the soil.

No harm of any definite recognisable kind may result for years from drinking such water, excepting, perhaps, occasional outbreaks of diarrhœa; but at last some person comes into the neighbourhood who is suffering from an attack of typhoid contracted elsewhere, or who is convalescing from the illness, and then the specific microbe reaches the water, and it becomes a deadly poison, bringing sickness and death.

This has happened again and again in the past, and

still happens. People's prejudice and ignorant conservatism is often the cause of the trouble. They are proud of the 'sparkling water' from their surface wells, and will talk of its wonderful health-giving or curative properties, refusing to listen to a word of possible danger until the peril is in their midst. Just as in the case of the Broad Street pump in Golden Square in 1854, no one will heed a warning until cholera or enteric have taught their own terrible lessons.

There is only one remedy. If ever we are so situated as to be obliged to drink water from a shallow well, or, indeed, from any doubtful source, *whatever may be local opinion as to its purity*, it must be boiled before being used for drinking, or for rinsing the teeth, for washing salads, or cleansing any food which is to be eaten uncooked.

No filtration can ever take the place of actual boiling; it is only by boiling that the microbes of disease can be destroyed. Let us remember, too, that the appearance of such water is no guide as to its safety; bright, sparkling water often owes its attractive appearance and seemingly pleasant taste to sewage impregnation.

Rain-water, collected in clean utensils and filtered through sand, gravel, or charcoal, would be much safer in many a district than the shallow well-water which the inhabitants drink.

Deep wells. Deep wells bring us water from a much lower bearing stratum. They tap water that has percolated down through cracks and interstices, having become filtered and cleaned in its long passage, and which now lies stored at too great a depth to be affected by surface impurities. Such water is liable to be very hard, to be poor in oxygen because not well aerated, and to contain many mineral constituents, but

is generally water that can be trusted as safe from all organic contamination.

Some of the best London water is obtained from wells sunk in the deep chalk, often to a depth of several hundred feet.

Deep wells ought not to be sunk in populous districts or in neighbourhoods where cesspools receive the sewage. Where, however, this cannot be avoided, extra precautions must be taken to line the sides with brickwork set in good cement and clay from the top to the point where the water flows in, and the top itself should be raised above the ground and well protected from surface pollution. Whenever any well is sunk, the direction of the movement of the ground-water must be ascertained, so that the well may be placed *above* any likely cesspools. If a drain must be carried anywhere near a well, the drain-pipes should not only be extra carefully joined, but they should be laid *in* concrete to prevent any chance of leakage into the ground near the well.

Artesian wells—so named from Artois, the province of France where the first one was tried—are deep wells which reach a still lower collection of water lying in a basin-like formation where two impervious layers outcrop on the surface. When this water is reached by boring the pressure of the surrounding strata forces it up the tube into the air.

Of the various sources mentioned, upland gathering grounds are best; deep wells also yield a trustworthy supply. River-water is always liable to suspicion, while shallow wells must be labelled dangerous.

Methods of distribution.

Water may be supplied to a house on either the constant or intermittent system.

By the constant system water is always

obtainable; it is fresher, purer, and cooler in summer, the pipes are always full, no cisterns are necessary, and the advantages from the point of view of convenience and safety in case of fire are very great.

The only drawback is that there is often much waste through carelessness in turning off taps or repairing leaks, and the leaving a garden hose to run at night, or some other reckless waste of water. But this can be prevented to a great extent by vigilant supervision and by the use of water-meters for registration.

By the intermittent system the water is turned on and off at intervals, and there are some very grave disadvantages. Besides the temporary inconvenience and the danger of lack of water at time of fire, there is the necessity of storage in cisterns, and the pipes, when empty, are liable to become corroded and to be fouled by impurities such as coal or sewer gas, which are sucked into the empty mains through pervious or leaky joints. Hence it is much to be desired that the constant system of water distribution should be adopted. The advantage of being able to draw water at all times direct from the main is very great from the health point of view. There should be a tap on the main in every house, so that drinking-water may be taken direct from the purest source possible.

Sometimes main water is temporarily discoloured from rust, and the water should then be allowed to run until it is clear before any is drawn for use.

Domestic storage.

The storing of water, whether in cisterns or jugs, should always receive careful attention. Water is a powerful solvent, and greedily absorbs gases and other impurities with which it comes in contact.

Cisterns.

Hence cisterns or water-tanks must be very carefully arranged and managed. They should not be made of lead; galvanized iron, stoneware, or slate set in cement may be used. But slate, when it cracks, is often mended or 'stopped' with white and red lead, which is highly dangerous if the water is soft.

A cistern should be in an accessible place for inspection and cleaning, in light, airy surroundings, where nothing dirty or unwholesome is kept, and where there can be plenty of ventilation. As examples of *unsuitable* places, cisterns are sometimes put in closets or in rooms which are used for the storing of rubbish and soiled clothing, or they are often put in the roof or so close to a ceiling that it is impossible to look into them or get a brush in for cleaning.

A cistern should always have a properly fitting cover, which, when broken, must be repaired so as to keep out all dust.

The bottom and sides of a cistern should be thoroughly cleaned and scrubbed once in six months if used for drinking-water, once a year if only used for storing other water.*

The supply of water to a cistern is regulated by a tap, which is opened or closed by the action of a floating copper ball; but as this is liable to get out of order, a waste or overflow pipe is provided. This waste-pipe *must never discharge into a drain or closet trap*, but always straight into the open air in some conspicuous place where an overflow would be detected.

* If, unfortunately, a cistern is of lead and cannot be altered, it is best *not* to scrub it out at cleaning-time, but only to thoroughly flush it, because as it grows old and coated it is not so likely to be acted on by soft-water. It is new lead that is most dangerous.

A cistern which supplies drinking-water *must never supply a closet direct.* Each closet should have its own separate little cistern, and if ever there is direct communication between the general cistern and any closet arrangement the water must *never* be used for drinking. Sometimes on a landing or in a closet a tap may be found attached to a pipe which comes from the cistern supplying a closet. This was always put, in bygone days, and may still be found in old houses, for the convenience of filling jugs and bedroom water-bottles upstairs. Nothing could be more dangerous than such water; it is nearly sure to be largely impregnated with sewer-gas, and a tap of this kind should be removed at once.

All utensils in which water is stored must be kept scrupulously clean, jugs and water-bottles as much as cisterns. Large-mouthed glass jugs in bedrooms are far more healthy than the narrow-necked water-bottle so difficult to clean and so likely to be kept covered by the inverted tumbler.

The individual's precautions and safeguards.

The water question is one of serious difficulty in many places. In spite of the advances and improvements of modern times, there is yet an immense amount of apathy and indifference on the part of public bodies about the quality of the water supplied, and a still greater amount of ignorance and prejudice on the part of individuals. Hence each person should know what precautions and safeguards can be adopted when there is danger, or even suspicion.

The first safeguard, as has been already noticed, is to *boil the water.*

Boiling is the only actual protection, and no amount of excellent filtration can ever do instead. Boiling

destroys any microbe life present in the water. Dr. Klein says: 'One minute's exposure to a temperature of 212° F will kill the bacillus of enteric. Even the spores of anthrax—so marvellous in their tenacity of life—are killed in one minute by boiling.' Two German bacteriologists of great repute give it as their opinion that 'no bacteria can tolerate a temperature of 100° C (212° F) for even a few minutes.'

Therefore we have always the one safeguard to fall back upon if there is doubt about the purity of water, and a small kettle and spirit-lamp is as necessary a part of luggage in country districts of England as it is abroad.

The trouble involved is sometimes urged as a reason against boiling water for a household. But it is only the drinking-water, or any water used for washing salads and uncooked foods, that need be so treated, including, of course, the water put in bedroom bottles. And even if it does mean some extra supervision and management, the trouble is surely worth while when we think of the risks from which it may preserve us.

Another objection to boiling water is that it becomes so flat and insipid in taste. But the water can easily be aerated and refreshened by pouring from one vessel to another from a good height and near an open window.

Filtration.

The second means of purifying water is filtration.

Filter-beds.

On a large scale river-water is filtered by water companies, the water being passed slowly through layers of sand and gravel.

These filter-beds have a three-fold action on the water, mechanical, chemical, and bacteriological. Impurities are caught in the meshes of the gravel and sand; the air in the interstices acts upon the finely divided water and

oxidizes it; bacteria which collect upon the surface help to destroy harmful organisms.

Domestic filters.

There are many domestic filters in the market from which we may make our choice. But whatever kind is used, it is absolutely essential that every part should be regularly cleaned, exposed to the air, and dried in an oven or in the sun.

The old-fashioned filters which were allowed to go uncleaned for months or years used to become so filthy that they themselves bred the very organisms and impurities which they were supposed to remove.

The best filters are those known as the Pasteur-Chamberland or Berkefeld filters, in which the water is passed through unglazed porcelain or infusorial clay. They are made in all sizes and prices. The cylinder of porcelain or clay must be removed and scrubbed weekly, and the whole receptacle cleaned. Once a month the cylinder must be boiled in a saucepan of water for an hour, and then allowed to cool before replacing.

Another well-known filter is that called Maignen's Filtre Rapide. In this the water passes through a mixture of charcoal and lime laid upon a funnel-shaped frame which is covered with asbestos. The cleaning must be done once in three or four weeks by taking the charcoal out and washing it in several changes of water, and then drying it in the sun or in an oven. A new 'charge' for the filter is required about once a year. In this arrangement the water passes through very rapidly, and when the whole is kept absolutely clean the results are satisfactory. But in all charcoal filters everything depends on the cleaning; dirty charcoal actually makes good breeding ground for microbes, and does far more harm to the water than good.

One advantage of filtration through charcoal is that any lead present is likely to be removed by chemical action. Phosphate of lime present in the animal charcoal acts on the lead, and forms a phosphate which is kept back by the charcoal.

Spongy iron filters allow water to pass through a preparation formed by heating iron ore with animal charcoal. The action on the water is partly mechanical and partly chemical. This filter must always be kept used, as the spongy iron when it becomes dry is useless.

A filter should always be kept in a cool, light, airy place, away from dust or any contaminating influence. Water should constantly be drawn from it; the filter should not be left with the same water standing in it for any length of time.

Tests of water.

If ever we are so circumstanced as to be in anxiety about the presence of lead, it may be useful to know of a simple test. Two white cups are filled with the water to be tested, and a thin glass rod dipped in liquid sulphide of ammonium is stirred in one of them. If there is no change in colour, and both cups look the same, there is no lead. But if the water which has been stirred assumes a brownish hue, then a few drops of hydrochloric acid are added, and if the discoloration disappears it is only due to iron; if it remains, then there is almost sure to be lead present.

Another simple, though quite rough, test for animal impurities is to fill two glasses with water, one with distilled water from the chemist's, the other with the water to be tested. A few drops of Condy's fluid is added to each, and if the water to be tested becomes of a brown hue and different to the other in colour, there is every likelihood that organic matter is present, and that the water is dangerous.

CHAPTER VIII

THE REMOVAL OF REFUSE FROM THE DWELLING—THE DANGER OF DECAY.

Part I.—House Refuse and Waste Waters

THERE is yet one more danger to be added to our list of those which particularly belong to indoor life. We have noticed *damp*, *darkness*, *dust*, *damaged air*, and *dangerous water* as enemies to health; but there is a sixth evil, which seems perhaps the worst of all to fight against, because it is liable to find entrance into the dwelling through so many different channels. This danger may be described simply as *decay*, and constant vigilance and unflagging care are needed in order to keep it at bay.

Underlying principles.

To understand the full meaning of this danger of decay we must remind ourselves of two of Nature's great unvarying laws.

The first is well enough known and recognised. Everyone understands that life of any kind on this earth means eventually death—that all things, whether animal or vegetable, if they have once lived must sooner or later die.

But there is a second law, indissolubly bound up with the first, equally sure and unvarying, the two together

making one unbroken chain. *All that has died must decay.* It matters not whether the living thing be animal or vegetable, large or small, complex or simple; from the body of a human being to the tiniest form of animal life, from an oak-tree to a cabbage leaf, just as surely as death follows life, so does decay follow death.

What do we understand by this term 'decay'? It means a taking to pieces, a splitting up into the original constituents of which the thing was made, a process sometimes described as decomposition, disintegration, or—if it goes on under unsatisfactory conditions—putrefaction.

There is great beauty and consolation in the truth of this wonderful law, for by it we learn that death is not the end of anything, but only a stage in its life history. Nothing is ever lost or destroyed in the realm of Nature; it is only changed into simpler forms of matter which are wanted over again in her great economy.

But there is another side to the question. While the process of decay is taking place—while dead things are being decomposed and prepared for other purposes—poisonous gases are evolved, foul materials are given off which contaminate the air immediately around, and are terribly dangerous to human life.

These gases constitute the danger of decay, and if men value life and health decomposition must never be allowed to take place within the dwelling, or even in its near vicinity.

Some of the gases of decay have an offensive smell, and mercifully we get warning of their presence, as in the case of the disagreeable odour of a stale egg, or of the water in which flowers have been kept too long. But others give off no particular smell, and occasionally

a house may be full of danger from the presence of sewer-gas from drains, or the foul emanations of a decaying rubbish-heap, with no particular warning of the evil influence at work.

Effects on health of the gases of decay.

It is impossible to exaggerate the deadly nature of these gases of decay. Now and then alarming proofs are forthcoming of their power to injure and kill. People have gone home to suffer from sore throat, or to die of diphtheria or some form of blood-poisoning, after just breathing in the effluvia from an open drain. Men have been suddenly overpowered by the gas in sewers or cesspools, and have expired before help could be obtained. The birth of a little child has meant death and tears instead of life and joy, because of the terrible fever which has stricken the mother through the badly-made drains or foul closets of the house.

But the most common, and by far the most disastrous, effects of these gases of decay are a general impairment of health, a lowering of vitality, which means the slow but certain preparation of the body for the attacks of disease from without, or the development of those illnesses from within to which the individual may be naturally predisposed.

In the midst of beautiful country districts, where air is pure, water good, food plentiful, and everything should make health possible and life long, we see people sickly, anæmic, short-lived, and liable to many ailments. We find a high mortality, especially amongst children, and a rapid spread of infectious disease whenever a case is introduced; and we discover the explanation of it all in neglected closets, open, foul-smelling stop-drains and filth-laden gullies, house refuse stored in heaps or tubs,

streets unscavenged, and everywhere those conditions which mean the ever-present influence of the gases of decay.

In towns these matters are often better supervised, and there is no doubt that in regard to this sixth danger of indoor life, the town dweller is, generally speaking, much better off than his country neighbour.

There are three classes of waste materials connected with the dwelling from which we may be injured by the gases of decay—house refuse, waste waters, and sewage. The rule in each case must be the same. *Get it all away from the dwelling as quickly as possible*, and far enough away to be sure that none of the gases given off during decomposition can find their way back to the house.

House refuse.

House refuse includes large and mixed collections of rubbish. Some of them, such as cinders, ashes, paper, rags, broken glass and china, dust from sweeping, hair-combings, and such materials, might be voted harmless enough in themselves, so far as the danger of decay is concerned. But house refuse also includes all sorts of vegetable and animal remains—food scraps and the refuse from cooking operations, bones, cabbage-leaves, potato-peelings, and a medley of materials which are bound to accumulate in a dwelling, and certain to undergo decomposition.

Methods of disposal.

In the country a good deal of this is used for pigs and poultry, the only danger being that it is often kept too long in pails or tubs, until it becomes a nuisance and injurious to health. The 'pig-tub' can be as great an evil as the rubbish-heap.

The old-fashioned country heap, often adjoining the walls of the dwelling, perhaps close to a bedroom window or dairy, upon which everything is thrown,

even bedroom water sometimes, and which is left open to the rain—to be made by constant wetting a still greater nuisance—is one of those abominations which ought to be deemed illegal, and a remnant of uncivilized life.

Little better is the arrangement still to be found in some towns known as the 'dust-bin.' This is a brick receptacle with a wooden lid, sometimes placed actually inside the house, but generally, as in London, outside the basement windows at the bottom of the area steps. The bricks absorb liquid refuse, the wooden lid is generally open or out of order, and by the end of the week—which is the shortest period likely to elapse between the visits of the dustman—the accumulation of decaying matter will give off noxious, unwholesome effluvia.

In some places the plan of getting rid of house refuse is to put boxes or pails in the street every day or once or twice a week, to be called for by the scavenger's cart. A vast amount of dust and refuse is thus scattered about to pollute the air of the streets. If such a custom is permitted, it seems at least a pity that people are not compelled to use covered receptacles, so that passers-by may be protected from disgusting sights and disagreeable smells.

If we turn from these most unsatisfactory methods of dealing with house refuse, and ask what ought to be done, for our own and other people's sake, the answer is that every particle of organic house refuse belonging to a dwelling should be *buried* or *burnt*.

Burying. In the country, and where there is enough ground attached to the house, everything not wanted for pigs and poultry can be dug into the earth. Just below the surface of the soil the processes of decom-

position go on without danger or offence to man. Multitudes of minute organisms—the scavenging bacteria—are found in the upper layers of earth, and it is their business, together with the assistance of moisture, warmth, and the air in the soil, to take to pieces all dead substances and turn them into harmless materials fit for the support of vegetable and plant life.

Two conditions must, however, be observed in this burial of house refuse. It must not be dug in too near the house, as all soil immediately round the dwelling must be kept as clean and pure as possible. Secondly, refuse must not be buried repeatedly in the same spot. There must be ground enough to allow of change of place, or otherwise the germs in the soil will become exhausted, and the process of natural decomposition will cease. If these two rules are observed, the burial of all kinds of rubbish in cultivated ground is a natural, scientific, and truly economical solution of the difficulty.

Burning.

In towns, where house refuse cannot be buried, then every scrap of animal and vegetable matter should be dried and burnt daily in the kitchen fire. This is not only a perfectly safe and pleasant, but also an economical plan. If the rubbish—*whatever it may be*—is rolled up in paper and dried on the top of the stove, it makes admirable fuel, and will not smell in the least during burning. It is very difficult to convince people of this last fact; the housekeeper who has never tried will not believe it possible to burn fish-scraps, vegetable remains, and such-like materials without a smell that will annoy the whole household. But it is absolutely certain that, provided all is thoroughly dried first, any ordinary house refuse may be burnt without anyone knowing of the operation.

Picture all that would be avoided in the shape of risks from rubbish-boxes and ashpits, the worry and annoyance of collection, the repulsive sights and smells of the scavengers' carts, if only each housekeeper could be persuaded to burn the house refuse daily in her own kitchen.

Storage and collection.

Supposing circumstances to exist where house refuse cannot be buried or burnt, and where, therefore, it must be stored on the premises for awhile and collected at intervals, there are certain rules which must be rigidly observed.

A sanitary dust-box.

The dust-box should be made of galvanized iron, so as to be non-porous; it should be round in shape and have a tightly-fitting cover, which should always be kept in place; it should be portable, so that it may be easily lifted and emptied straight into the cart. It should be kept as far away from the larder or dairy window as possible, and occasionally, after clearing, it should be left empty and exposed to sun and air for a day to be purified and dried. Wet materials, like tea-leaves (when not wanted for sweeping), scraps from the sink-basket, and vegetable remains should be rolled up in paper and dried before putting in the dust-box, and a weekly collection by covered carts should be insisted upon. This is a point on which local authorities, despite many boasted regulations, need frequent reminders. But when taxes are paid for road cleansing and refuse removal it is only fair to insist that the work is done for us regularly and satisfactorily. The dustman, like most other British workmen, will skip his work if we will let him.

Finally, let us remember that it is the duty of all who work for the physical welfare of the poor to try and

educate them on this subject. House refuse seems to the uninstructed a very trivial matter; such rubbish is thrown everywhere and kept anywhere, without a thought of danger to health, and many a sore throat, skin complaint, or poisoned wound has been traced to this apparently simple cause. In districts where collection can be insured, we may allow the sanitary covered dust-box is a safe arrangement; but in those numberless places where no such thing as a scavenger's cart is seen, then 'bury or burn' must be the maxim enforced.

Waste-waters.

The second class of dwelling refuse, known as waste-waters, includes soapy, greasy water from scullery sinks, lavatories, and baths, and, indeed, every kind of liquid refuse except sewage. A wide belief prevails that such material is perfectly harmless, and may be thrown out of the back-door, or stored in tanks for garden use, or left to stand in ditches or gullies or any receptacle inside or outside the house. A little knowledge will, however, quickly convince us that this is decaying matter of a dangerous and disgusting nature, which, if kept about the dwelling, is liable to become as grave a nuisance as sewage itself. Soapy water alone can quickly become very offensive; and when it contains dead cells and oily matter from the skin, animal and vegetable refuse from the washing of plates and kitchen utensils, and dirt of all sorts from the cleaning of the house, we then have a foul and unwholesome collection of decomposable substances.

Hence, the principle we must emphasize is that waste-water must not be kept in or about a dwelling one minute longer than is absolutely necessary, and it must be carried away from the house and the soil about the house by the quickest and most complete manner possible.

Waste-pipes.

Where the water-carriage system of drainage is in use, waste-water is generally carried away to the drains and sewers. In such cases, the first essential to safety is that no waste-water shall have any direct communication with the drains.

Scullery sinks, lavatory basins, and baths must always be placed against an outside wall, so that their waste-pipes may be short, and may go straight through the wall to *terminate in the open air*. If they are connected direct with the drain, they form so many channels through which sewer-gas may find its way into the dwelling. A sink or bath leading by means of its waste-pipe into a drain has over and over again been the cause of illness and death in a house. This safeguard in regard to waste-pipes is spoken of as 'disconnection'; and by the term is merely meant the cutting off of the end of waste-pipes so that they have no direct communication with the drainage system, and so that *we can see the water* discharged from them. The disconnected end of a waste-water pipe should empty its contents over a grating, or over a smooth, sloping channel leading to a grating, beneath which is a large-mouthed trap, known as a gully. Water stands in this trap, and its outlet leads to the drain proper.

Traps on waste-pipes.

Besides disconnection, it is wise to have waste-pipes trapped. By this is meant the putting of a syphon or U-shaped trap in the course of the pipe just under the sink, or bath, or lavatory basin; and it is generally supplied with a screen, which can be unfastened for the cleaning of the trap or the removal of any obstruction. The object of this arrangement is to prevent the pipe which passes from the appliance to the open air becoming a channel for the

admission of air into the house. The disagreeable smell so often to be noticed about a sink or bath cannot come from the drain if the pipe is disconnected, but is just the smell of the air which has passed up the dirty, soapy pipe, and which, of course, comes straight into the dwelling if there is no barrier of water to prevent. These traps on waste-pipes must be rinsed and filled by allowing some clean cold water to run whenever the appliance has been used, otherwise the trap will remain full of dirty soapy water, which may give off a disagreeable odour.

But let us be careful here to distinguish between what is expedient and what is absolutely essential to safety. *Disconnection of waste-pipes is essential*, and should be insisted upon even in the poorest of dwellings, while traps on wastes can only be said to be a wise precaution against unpleasant smells from dirty and unsuitable air-inlets.

The cleaning and management of gullies.

Whenever a sink or any waste-water appliance has been used, some clean water should be poured down to clean and fill up the gullies. These traps often become a great nuisance because left full of dirty water.

Once a week, at least, all the gullies round a house should have their grating covers removed, and the sides and bottoms scrubbed round and thoroughly flushed with clean cold water so as to clear away any solid or greasy materials that may have clung to the sides or settled at the bottom. At all other times the grating covers must be kept carefully in position, and people should be instructed never to remove these gratings when pouring away dirty water. Uncleaned, partly blocked gullies become very offensive and often like

miniature cesspools owing to the very nasty purposes for which they are used. In country districts they are often to be found made of bricks, with just a hole left at the sides from which the water may find its way into the drain. This is quite wrong, because bricks absorb moisture, and soon get very filthy and foul-smelling. Gullies should always be of glazed stoneware; they should never be put inside any part of a house. The fewer of these traps round the dwelling the better. When there are several waste-pipes, they ought to be arranged to meet over one common gully, as one or two of these traps are much more likely to be looked after and kept clean than several.

In hot weather gullies are specially liable to become dry from evaporation, hence more frequent flushing is necessary. It must not be forgotten that an empty gully becomes a channel of communication with the drainage system.

Grease in the scullery gully.

The gully under a scullery sink waste-pipe is often a special difficulty owing to the accumulation of grease from washing up and cooking operations. Sometimes a movable interior in the shape of a basket or bucket is placed within the gully so that it may be taken out and the grease removed. In houses where expense need not be considered and there is much cooking, an admirable arrangement is that of an automatic flush-tank communicating with the scullery sink gully which discharges water at regular intervals, and with such force that the grease is broken up and washed away. In simple dwellings the grease in a trap can easily be broken up with a stick, and then washed away with plenty of cold water. The common idea is that grease may be got rid of by pouring down

hot water; but even supposing it is melted and carried out of sight, it will only collect again further along the pipes. All that is necessary is to break up the grease into small pieces and then to wash it away. *Hot water is always bad for drains*, and the less we use the better, so it should not be resorted to for flushing purposes.

Waste-water appliances.

The waste-water appliances to be met with inside the dwelling are sinks, baths, and lavatory basins. Housemaid's sinks for the receiving of bedroom slops are, of course, not included, because they are intended for the conveyance of liquid excreta, and must be considered with closets.

The scullery sink.

The scullery sink should be placed against an outside wall with a window above it opening to the external air, so that all may be kept fresh and pure in its vicinity. It should be made of glazed stoneware or slate, with a rim deep enough to prevent splashing, and a slope towards the grating which carries off the water. The holes of this grating must be small enough to protect the pipes from solid particles, or anything that might cause a block, and it should be permanently fixed to prevent interference.

Sometimes a most objectionable and insanitary device, known as a bell-trap, is found in a sink. The cover of this is nearly always displaced or broken, and the pipes beyond get constantly blocked.

A sink-basket made of perforated enamelled tin or zinc is a great protection, so that all washing-up water may be poured through it; the solid particles will collect in the basket, and can be cleaned out and burnt frequently.

The sink can be cleansed with either salt or soda, but salt is best, and a little rubbing with a rag dipped in

paraffin oil quickly removes all black greasy marks. Tiles may be put round the appliance if the wall is likely to be splashed, and if properly constructed and managed there need never be the slightest smell about a sink, even in the homeliest dwelling.

Baths. There is no greater comfort or help towards the preservation of personal health in a house than a bath. It is becoming more and more general to fix them even in the simplest dwelling, and where expense prevents the luxury of a bathroom with hot and cold water-supply, it is easy to sink a bath in the floor in the front of the kitchen fire, fitted with a properly trapped disconnected waste-pipe, the water to be supplied from kettle or boiler. But in baths and lavatory basins, as in sinks, care must be taken lest danger lurk behind our comforts and conveniences. The one safeguard of disconnection is absolutely essential, and we must be able to see for ourselves that the waste-pipe discharges its dirty water into the open air, either over a gully or over the hopper head of another waste-pipe which terminates above a gully. This waste-pipe is prevented from becoming an air-inlet if it is trapped just under the bath, as in the case of the sink waste-pipe.

If there is an overflow-pipe it must not be carried into a closet trap or drain. Like all overflow-pipes, it must be carried straight through the wall and end in a conspicuous place where an escape would be noticed. Overflow-pipes are meant to be '*warning*' pipes, and hence should be always visible. Sometimes a safe is fixed under a bath to protect the floor, and the pipe leading from it must be treated as an overflow-pipe in the same way.

Whenever a bath or lavatory basin has been used, the cold tap should be turned on while the hot waste-water runs away, and then clean cold water should be allowed to fill up the traps.

Rain-water pipes.

There is one more kind of waste-pipe which may be found attached to a dwelling. Unless the rain-water from the roof is collected in some receptacle for domestic purposes, it has to be carried away as waste-water. Under these circumstances, rain-water pipes must be disconnected and discharged into the open air over a gully in the same way as other wastes. In old houses we may still find rain-water pipes carried direct into drains, or terminating in the ground close to the house, to be a constant cause of damp. The first is a very dangerous arrangement, because sewer-gas may find its way through the joints or top of the pipe, and so into the house through adjacent windows.

So far we have only considered methods for carrying off waste-water where there are drains and sewers. What can be done in unsewered areas? in places where the closets are of the earth or pail kind, and people are left to dispose of soapy, dirty water from the dwelling in any way they like?

The usual custom will probably be to turn the refuse water into some stream or ditch, or, more often still, to throw it on to the street or ground near the house. The danger of such a practice is realized when we remember that polluted streams and ditches, or soil saturated with offensive putrefying materials, all help to make breeding ground for disease germs.

In small towns and villages the only proper plan is to have a common system of pipes to carry off waste-water

from all the dwellings to a safe distance, but when houses are isolated and have gardens, waste-water can be dealt with by each householder in one of the following ways:

It may be carried away by hand, and emptied on to a field or garden away from the house;

Or a stone-pipe drain may be laid, with a proper stoneware gully at its commencement, to carry the refuse to a *water-tight* tank in the garden, whence it may be pumped or ladled out for watering purposes;

Or the same sort of drain may be made to lead to trenches, or brick channels, or loose stone pipes, from which the waste-water can escape and flow over ground well planted with cabbages or other vegetables. Good crops of garden vegetables can be obtained by such a plan, and the waste-water is disposed of safely and economically.

Where such pipes for the conveyance of waste-water run near a well, extra care must be taken in their construction, and they ought to be laid in concrete to prevent harm from possible leaks.

CHAPTER IX

THE REMOVAL OF REFUSE FROM THE DWELLING

Part II.—Sewage

THE third class of refuse to be considered seems to present special anxieties, because of its terrible effects on health and the sad penalties paid in the past both by individuals and communities for ignorance and neglect. Everyone should know what *ought to be done*, and everyone should know how to protect themselves and their individual homes if they live in districts where the very reverse of what ought to be done is tolerated or even countenanced.

There are various plans in vogue, and many different opinions are held by sanitarians as to the best methods of removing and dealing with sewage, but on one point all are agreed: if human beings are to be healthy, everything—solid or liquid—must be taken away immediately and completely from the house and its vicinity, and this must be effected by the simplest, cleanliest, quickest means possible.

We shall consider the subject solely from the domestic point of view, only discussing the final disposal of sewage in so far as it may sometimes have to be arranged by the individual.

The water carriage system.

The most usual custom in towns, and that which seems best suited to English manners and ideas, is known as the water-carriage system. The sewage is conveyed away in water, by means of certain appliances and pipes, to some spot where it is finally deposited or dealt with. This final spot may be the sea or a river; or the sewage may be carried on to sewage farms for agricultural or garden purposes; or it may be dried and burnt together with house refuse in huge furnaces known as 'destructors'; or it may be treated chemically or bacteriologically until the whole is changed into simple harmless forms of matter.

Where the water-carriage system is in use, we shall find within the dwelling water-closets and pipes leading from them to the soil-pipe and house-drain.

Water-closets.

The first matter that concerns the housekeeper is the water-closet itself. Even in these enlightened days there are few matters about which people are more careless and ignorant, and closets are often dark, gloomy apartments, unventilated, dirty, and evil-smelling. Anything and everything is thrown down the apparatus. It is not unusual to find a drain blocked with inkpots, glass bottles, broken crockery, cloths, brushes, and all sorts of articles thrown down through closet-pans or uncovered gullies. Nothing but gross ignorance could lead to such mistakes.

The apartment.

The position of a closet apartment should be as separate and distinct from the house as possible. Theoretically, out of doors is the safest place, but there are grave disadvantages connected with the inconvenience and inaccessibility of outside closets: people are deterred from using them freely, and

excreta is apt to be kept in obscure corners of the house to be taken out when convenient—a disgusting practice, which may cause serious illness. So we may assume that an indoor water-closet is the best arrangement.

There must always be, at least, one outside wall against which the appliance can be fixed, so that its pipe can pass straight out of the house at once.

The door of the closet should fit well, and should *always be kept shut*; indeed, could we choose the best, double doors, with a ventilated lobby between, are desirable. The room should be well lighted by a large window, part of which can be kept permanently open. (According to the Local Government bylaws, the window of a closet must 'never be less than 2 feet by 1 foot, exclusive of the frame, and opening directly to the external air.')

Besides the window of a closet, there should be a perforated brick or iron grating in the wall, or a shaft run up through the roof, so as to insure by an inlet and an outlet thorough ventilation apart from the door.

A closet should never be placed near a larder, or dairy, or in or adjoining a nursery, and the fewer closets connected with a dwelling the better.

The walls should be limewashed, distempered, or covered with a washable varnished paper, and the floor overlaid with camptulicon or oilcloth. Carpet is entirely out of place; one small movable mat to protect the feet is all that should be allowed, or a small square of cork carpet is better still.

The closet appliance.

With regard to the apparatus itself, by whatever name it is known, the simpler its construction the better. There should be no wood-work about it except a hinged seat, and if old

wood casing cannot be removed it *must* be made to open, so that every part is accessible and can be kept clean and dry.

There are many varieties of good closet appliances in the market, and happily some of the simplest and best are the least expensive. Whichever is chosen, the rules to be borne in mind are the same.

There should be as little metal work about it as possible. It should be self-cleaning; the shape of the basin should be such as to allow of its sides remaining unsoiled during use, while the water supplied, and the flushing rim which conducts the water, should be so constructed as to keep all parts of the apparatus cleaned each time of use. The trap beneath the basin should be a simple bend of stoneware or lead (stoneware by preference), shaped like a P or S, with no angles or corners, and holding enough water to make a complete barrier to the passage of gases. The trap, as well as the basin or pan, should be entirely above the floor, so that no part is inaccessible or hidden.

Each closet should have a cistern of its own, so that no water supplied to a closet may come direct from the general cistern or main. Small cisterns, known as water-waste preventers, now generally fixed over closets, make the water-supply entirely distinct.

The pipe which passes from the closet trap should go straight through the wall and join the pipe outside, known as the soil-pipe. The junction between the earthenware trap and the branch pipe is very important and difficult to make. It should be on the inside of the wall, so as to be under observation. Closets in olden days were often placed in the centre of the house, and the pipes leading from them had to travel long distances

under floors and amidst other rooms before they finally left the house. Thus, many leaks might occur undiscovered, and gases from drains find their way into the dwelling.

'Short Hopper' closet.

An example of a simple satisfactory sort of water-closet is that known as the 'Short Hopper.' It is provided with a flushing rim which distributes the water over the whole of the basin, and therefore is easily kept clean. The trap is of glazed stoneware, of a simple and effective kind, and is placed above the floor level. But every closet that complies with the conditions mentioned may be considered satisfactory.

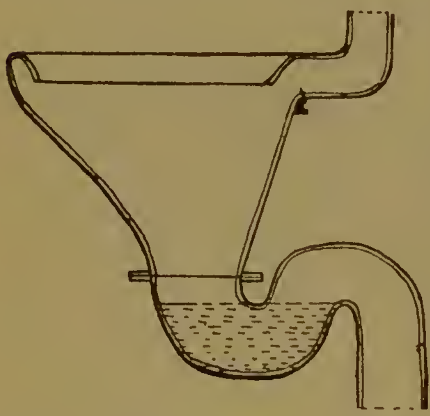

FIG. 2.—'SHORT HOPPER' CLOSET.

Valve-closet.

Valve-closets are more elaborate and costly, and, unless of the best type, are apt to get out of order. The trap is below the floor, and a wood casing is usually necessary. There is often an overflow pipe leading from perforated holes at the side of the basin which leads into the valve-box and trap, and may become a source of harm unless efficiently trapped. The especial advantage of valve-closets is that owing to the large quantity of water kept standing in the basin, everything is more completely and rapidly removed than in other arrangements. But a valve-closet does not answer to the condition of simplicity.

There are one or two sorts of water-closets to be

especially avoided, and they are still to be found in houses that have escaped inspection, or are on old property.

The 'pan-closet.'

One is known as the 'pan-closet.' It consists of a basin, below which there is a metal pan in which the water stands. When the plug is pulled this pan is swung down, and the contents are thrown into a large iron 'container,' which is always full of bad gases, becomes most filthy from splashing, and cannot be reached for cleaning. The iron container leads into a large lead trap, called, from its shape, a D-trap. It is a horrible contrivance, with angles and corners in which filthy material collects, and which are never cleansed by the water passing through. The lead becomes corroded, and after a time literally eaten away, by the influences of the gases constantly present. Sometimes a lead safe or tray is placed under the closet to protect floor and ceiling, and from this a waste-pipe is generally carried into the D-trap, thus forming another channel for the passing of foul air into the dwelling.

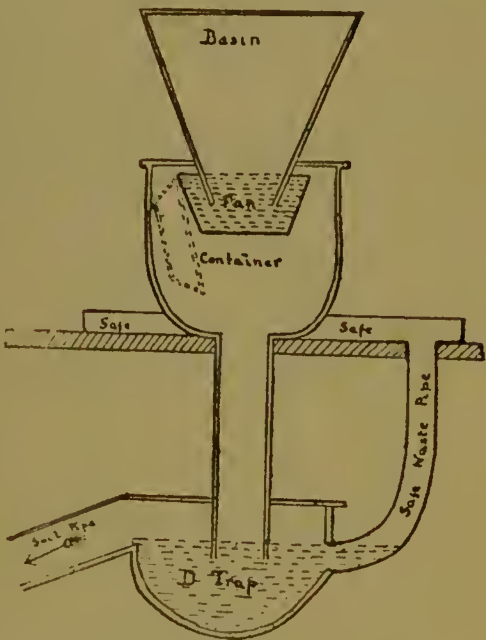

FIG. 3.—OLD PAN-CLOSET.

These pan-closets, with their containers and D-traps, have been the cause of innumerable cases of illnesses in houses, and no one who suspects the existence of such an insanitary apparatus should rest content until it has been removed, and the simple basin and trap of a modern closet fixed in its place.

'Long Hopper' closets.

Another very bad closet is known as the 'Long Hopper.' It is often found in the basement of houses in servants' closets, and may be recognised by the long conical-shaped basin which terminates in a small aperture at the bottom and holds no water. Because of its shape the side gets very splashed and soiled, while the opening becomes easily stopped up because of insufficient water flushing. The dirty appearance and foul smell of these closets is a proof of their unsuitability for the purpose of removing sewage 'quickly, completely, and cleanly.'

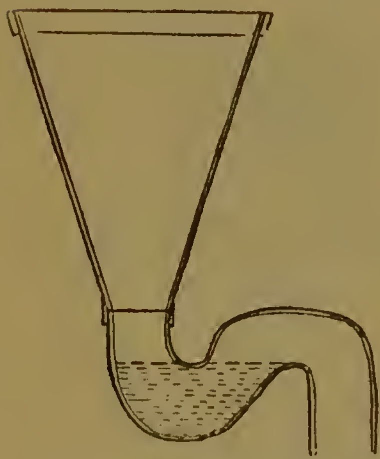

FIG. 4.—'LONG HOPPER' CLOSET.

The management of closets.

Some people have an idea that if once the sanitary arrangements of a house are properly constructed, closets and drains and all such matters may be left to take care of themselves. But this is not the case. Even the best contrivances can easily be put out of order by careless treatment or rough usage. Water-closets require to be properly managed as well as to be properly constructed.

Nothing must ever be thrown down, excepting that for which the appliance is intended. Hair-combings, matches, nightlight cases, and all such bedroom rubbish, should be consigned to the kitchen fire, and not thrown into utensils which may be emptied down a closet.

If pails of bedroom water are poured down closets, any wood casing or wooden covers must be opened so as to prevent splashing, and the pouring must be done slowly, with a good rinsing of clean water afterwards.

The closet basin and rim, and all that can be reached of the trap, should be cleaned once a week with a 'sanitary brush' made for the purpose, though an old scrubbing-brush is almost as good.

Of course, the chain or plug must be pulled, and the closet flushed after use; but it is not so generally known that it is a good plan to do this *before use* also, as the moistening of the soil-pipe helps to keep it clean and prevents material from adhering.

The more all appliances connected with drains are used the better. An unused trap is always liable to become dangerous from the evaporation or fouling of the water. Hence the old-fashioned custom of having a 'best' closet meant danger, because a closet can only be safe if constantly used and flushed.

When houses are shut up for holidays or left for a season, the weekly flushing of every single appliance should be planned.

Especially in the dwellings of the poor, closets need regular inspection and supervision. The horrors of the closet in the courtyard shared by many people must be known to all who have visited in the poorer parts of our cities. Nothing can avail by way of improvement under these conditions unless there is regular periodical inspec-

tion, to see that appliances are intact and free from blocks; that they are flushed and ventilated; that floors and seats are kept clean, and walls limewashed at least once in three months.

The disinfection of closets.

Many of those who know nothing about the proper management of drainage appliances take refuge in the use of disinfectants. They are comforted by the strong odours of carbolic powder or chloride of lime, and fancy that because one smell is masked and overpowered by another there is no more cause for anxiety. But the sense of security given by the use of these things is false and dangerous. If there is a bad smell in a closet we want to discover its cause, not cover it by another odour. In very unsatisfactory closets which we cannot have altered, or in the case of closets shared by many people who may not all be in a good state of health, the use of Jeyes' fluid, or carbolic powder, or chloride of lime, might help to purify the pipes and counteract harm. But a properly-constructed, well-managed closet needs no disinfection unless in time of special illness; plenty of fresh air and clean water will keep it quite sweet and wholesome.

Slop-sinks.

Another apparatus sometimes met with in houses drained by the water-carriage system is a 'slop-sink,' or housemaid's sink. It is intended to take slop-water and to save closets from being used for this purpose. Slop-sinks consist of a large basin, specially shaped for the emptying of great quantities of water, and a trap beneath similar to that of a closet. Beyond the trap the pipe passes straight into the drainage system; hence a slop-sink must always be treated as a water-closet in matters of management.

After use it must be flushed with clean water, and as

it will probably be only used once or twice a day, some clean water should be run through in the intervals. A perforated grating or iron bars should be placed over the outlet aperture to prevent bits of soap, or cloth, or other solid matters getting into the pipe, and the cupboard or room in which the slop-sink is placed must be well ventilated.

Slop-sinks are sometimes fixed in or adjoining nurseries, to afford facilities for the washing of children's clothing, and the removal of waste-water. But it is a thousand pities to have any such apparatus—especially one connected direct with the drains—in or near the apartment used by the most suspectible members of the family.

The soil-pipe. Branch pipes from water-closets and slop-sinks join a pipe which leads to the drain, known as the soil-pipe. As it connects direct with the drainage system, and, indeed, forms part of it, we can guess that it is a pipe of great consequence.

The position of the soil-pipe is of importance. In former days, when pipes on external walls were deemed a disfigurement, and all arrangements for carrying off refuse were supposed to be hidden from sight, the soil-pipe was generally to be found passing down the corner of some room or passage, often through the larder itself, and hidden from view by a wooden panel; or it might have been found built into the wall itself, and thus, hidden and inaccessible, it could never be examined, and leaks went on undiscovered and unsuspected for years. We may often find damp patches on the internal walls of a house which have come from a leak in a hidden soil-pipe, and which no one discovered or thought about until there had been illness, or even death, amongst the inmates.

It is now well known that a soil-pipe should always

be put outside the house. The smaller the part of the drainage system within the dwelling the better, and the branch pipes from closets must pass straight out to join the soil-pipe in the shortest and most direct way possible. This pipe must pass upwards in a straight line to several feet above the ridge of the roof, without angles or bends. Every bend in a pipe diminishes its ventilating capacity, and as the one object of carrying the soil-pipe upwards is to help ventilate the drain, it is a thousand pities to have the curves or bends we so often see.

The soil-pipe must be the same size through its entire length—'full-bore,' as it is termed. We may often notice a smaller piece joined on to the soil-pipe beyond a certain point, the extra piece being generally described as the ventilator. But air will pass more freely, and the whole arrangement be safer, if the same sized pipe is carried up to its extremity, where it must open freely to the air at a spot well removed from a window or the mouth of a chimney.

The material of which the soil-pipe is made should be very strong and durable. It may be of iron, as long as this is of a strong kind with some protecting coat to prevent rusting, and joints are carefully finished by what is termed 'caulking' with yarn and lead. Or it may be of lead—that known as 'sheet' or 'drawn' lead without any seams being best—with wiped, soldered joints.

Some authorities consider galvanized iron better than any other substance, because less liable to corrode. Occasionally a soil-pipe is to be seen made of stoneware; this is absolutely unsuitable, as the sockets break.

And amongst those pests of society, the speculative jerry-builders, there are men to be found who will put up

a soil of thin 'rain-water pipe' iron, or even of zinc, without the least regard to the risk of using such thin and flimsy materials.

It is wise to have the average iron soil-pipe painted about once a year, and the joints examined and made good. Sun and air affect pipes outside the house, especially when in exposed positions.

The house-drain.

At the bottom of the soil-pipe comes the house-drain. When it receives the sewage from one house only, the drain belongs to the individual, and therefore it is important to know the principles upon which its safe condition depends. The place where the soil-pipe ends and the drain begins is a very important joint, and one where a leak often occurs through bad construction. If any unusual moisture is seen in the ground or on a wall near this point, or any disagreeable smell noticed, the junction should be immediately examined. Builders are meant to unite the two by what is called an 'easy bend' of pipe, so that there may be no angles or sudden turns in the line of union.

The drain itself should be made of good, sound, glazed stoneware pipes carefully fastened to one another by cemented water-tight joints, and laid with a slight, even fall, so as to insure the steady flow of all solid and liquid matter towards the termination. If the drain is laid in any artificially-made ground, such as the site of old rubbish-heaps, or if the soil be of a kind likely to move and give, the pipes should be laid on a bed of concrete to keep them firm and steady. When a drain has to be carried under a house or near a well, it should be laid entirely *in* concrete, so that all leakage into the surrounding soil is impossible.

In country places and neglected districts drains for

the removal of sewage may often be found made of loose stones or bricks, sometimes covered in with wood. All the old London drains were once of this type. Such channels are literal death-traps—a means for accumulating decomposing materials and of contaminating the soil. No one who lives where any of these old drains might be found should rest content until they have not only been abandoned, but *entirely removed.*

The intercepting trap.

The house-drain, whether long or short, must eventually terminate in the sewer, or perhaps a cesspool.

In either case it is easily understood that some arrangement should be devised for preventing the passing of foul air and gases up the drain, and, possibly, into the house. Without some sort of barrier, the drain of a house serves as a subterranean channel of communication with the main sewer and other people's drains. Hence it is customary to insert a particular sort of trap at the end of the drain. This is known as the 'intercepting trap.' It is a contrivance of glazed stoneware, which, besides the actual trap or bend which holds the water, has also a 'raking,' or 'inspection' arm (A), which allows of the cleansing and clearing of the drain at its junction with the sewer.

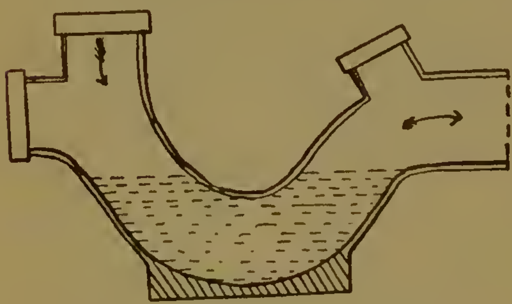

FIG. 5.—INTERCEPTING TRAP.

As a part of this intercepting trap there is another arm or opening *on the house side of the water* (B), which

can, by the addition of a pipe, be carried up a wall or a tree to open at some convenient spot.

This opening gives us the fresh-air inlet for the drain, and thus the ventilation is complete. Fresh air enters at the intercepting trap, and the outlet is secured by the open end of the soil-pipe, so that a current of fresh air is constantly passing through the drain and soil-pipe, diluting any gases that may be present, and relieving any pressure on joints and traps.

Three essentials to safety in the w.c. system.

Three conditions may be summarized as essential for safety when the water-carriage system is in use in a dwelling—disconnection, ventilation, and interception.

By disconnection, all waste-water pipes are cut off from any direct communication with the drain, and discharge into the open air.

By ventilation, fresh air is always kept circulating through the drain and soil-pipe, finding its entrance by the air inlet of the intercepting trap, and its outlet by the open end of the soil-pipe.

By interception, each house is guarded from any direct communication with the main sewers or other people's drains.

Manholes.

Intercepting traps are often placed in chambers at the end of the drain called 'manholes.' These are inspection chambers, constructed so that all the various branch-pipes bringing waste-water from gullies, as well as the drain from the soil-pipe itself, may meet at the one place where they can be examined before entering the intercepting trap. The object of this arrangement is to allow of access to the drainage system, and in the case of large houses there may be many manholes at different parts.

It is strange how often these manholes are neglected. People who never trouble about having them opened and cleaned would be surprised how very offensive and filthy they become, thus forming reservoirs for noxious gases, which may find an exit through the air-inlet pipe, or through dry gullies to the house itself.

A manhole should be opened once in six months, and the whole interior cleaned and flushed, together with the intercepting trap itself. The cover of the manhole must be securely fastened down again with cement or grease, and these are matters which must not be left to the conscience of the average plumber, but should be supervised by the house-manager, who, whether man or woman, can, at least, tell if all looks clean and smells sweet.

Once more, before leaving the subject of the water-carriage system, let us remind ourselves that, despite the most perfect appliances and good construction, there will always be need of unremitting care and cleanliness.

And where drains are unsatisfactory, closets old-fashioned, and everything seems to fall far short of the standard of safety, an immense amount can be done to ward off danger by means of plenty of ventilation and constant flushing with clean cold water.

Testing drains.

There are various methods of testing the condition of drains and their accessories. Some are only possible with the assistance of workmen and special apparatus. The hydraulic, or water test, is the most powerful, and should always be used for a newly-laid drain before it is covered in. The test consists in plugging up one end, and filling the drain with water from some gully at its highest part until the water can be seen standing, and the drain is therefore known to be full; a mark is then made to show the level

of the water, and if after some hours no subsidence has taken place, the joints and pipes are evidently sound. If the water has sunk below the marked place, it is a sign that some has escaped, and that there is a leak somewhere along the drain.

Another test is that of smoke. It is of no use for the drain, but can be made to test the soil-pipe and its connections with the house. A smoke-rocket is generally used, and pushed up the drain near the foot of the soil-pipe either at its outlet in the manhole or in an aperture made for the purpose, which must, of course, be made good afterwards. After the smoke is seen issuing from the mouth of the soil-pipe, this must be stopped up to prevent further escape, and thus the smoke is left to find its way through any leaks or weak connections if they exist.

But the housekeeper can use a much simpler contrivance, known as a 'Kemps' drain-tester,' to satisfy his or her mind of the closet joints and soil-pipe connections. The little cases can be obtained through any sanitary engineer or plumber at the cost of one shilling each. It is best to buy them fresh when wanted rather than keep them in the house. The lid has a string attached to it, and this must be uncoiled and the lid held or fastened to prevent its going with the rest; then the case is dropped into the closet water, and two or three pails of water thrown down with force to carry it as far as the string will allow. After twenty minutes the string may be pulled up, and only a little wire coil will be left to prove that the test has 'gone off.' If there are no leaks and the soil-pipe ventilation is good, nothing more will be noticed than a little smoke issuing from the top; but if there are any leaks, a pungent and very disagreeable smell will be immediately detected in their neighbourhood.

Another simple test is to pour two tablespoonfuls of oil of peppermint in a pail of hot water down the highest available point, such as an upstairs closet, taking care to have the open top of the soil-pipe closed. Another person who has not handled the peppermint must be on the look-out for smells denoting weak spots in the pipes. The closet seat and door must be kept shut during this test as the smell so easily escapes, and may mislead.

One way of testing if the drains and branch pipes are clear is to have the manhole opened, and then watch while someone pours down some coloured water from the different points, such as closets and gullies. If the water appears quickly the pipe is clear; if there is delay, or discoloration, or smell, then there is need of flushing and cleaning.

Cesspools.

In many districts where there are no sewers we still find cesspools constructed for the reception of the sewage of the dwelling. Inside the house water-closets may have been fixed, and all the arrangements be as is usual in the water-carriage system, but everything is finally conducted to a cesspit, or 'dumb well,' as they are sometimes called, and this is supposed to be cleared at intervals. As the arrangement rests with the individual under these circumstances, it is well to be clear about risks and safeguards.

Cesspools may be wrong in theory—it is always a bad principle to store refuse—but there are often occasions when no other arrangement is possible, and a cesspool need not be a source of danger if properly constructed and managed.

The following rules, according to the model bylaws of the Local Government Board, should be observed for safety:

A cesspool must be easy of access for cleaning, and be so placed that the contents need never be carried through a dwelling.

It should never be at a less distance from a house or source of water-supply than 50 feet.

A cesspool must be water-tight. One of its greatest disadvantages is the risk of the soakage of decomposing material into the surrounding soil. Hence its walls and floor must be made of good brickwork and cement, covered everywhere with 9 inches of 'well-puddled clay.'

It must be ventilated, and if the ventilating pipe is carried up a tree, as is often the case, care must be taken to secure a strong support, lest the joints are injured by wind movements.

A small cesspool, which necessitates the removal of its contents every three months, is infinitely safer than one of the common huge receptacles, which may be left uncleaned for long periods.

The drain leading to the cesspool should terminate in an intercepting trap, and have exactly the same arrangement for inlet ventilation as already described. There must never be any direct unbroken connection between house and cesspool. An interesting example of the importance of this safeguard occurred in a house on the sea-coast of Devonshire, where, despite the most modern fittings and appliances, some illness was always a trouble amongst the children. The house-drain passed down a long garden and terminated in a cesspool, which was well constructed and cleansed every six months. Waste-pipes were disconnected, the soil-pipe and closets were satisfactory, and yet at times a disagreeable smell was noticed in the nursery. On examination, it was found

that the drain had no intercepting trap, so that a closet adjoining the nursery, and only occasionally used, was in direct communication with the cesspool. If from any disuse or misuse the water in the closet were lowered beyond its proper level, there was nothing to prevent bad gases finding their way from the cesspool through the drain and directly into the nursery. When an intercepting trap had been put at the end of the drain and the communication thus broken, no further smell was ever noticed, and sore throats and diarrhœa disappeared.

Obviously cesspools are impossible in towns, because of the nuisance likely to arise during the removal of contents, and also because of the impossibility of placing them at a sufficient distance from all dwellings.

In old houses, both in town and country, careful investigation should be made for old drains and cesspools. In cellars, passages of basements, or basement apartments, a look-out should be kept for inlets to drains, flags that indicate—by their different appearance, their looseness, or the mark of a ring—that underneath them may be old tanks, cesspools, or communications with drains, through which rats may find entrance. And when a house is redrained all such places should be cleaned out and stopped up, though only *after* any old pipes and drains have been entirely removed.

'Conservancy' methods of 'dry' closets.

We must now proceed to notice some of the most common methods of removing sewage from dwellings in districts where water-closets are unknown. All other plans besides that of the water-carriage system are spoken of as 'conservancy' methods, because to some extent and for some period, however short, sewage is bound to be retained on the premises.

Pail-closets. In the pail system, when well managed, we have the best arrangement that can be made under the circumstances. In Manchester, Birmingham, Rochdale, and many cities and towns, pail-closets are largely used, and are considered by some authorities to be simpler and safer than water-closets.

The pails are made of galvanized iron or tarred oak, and are provided with close-fitting lids, which prevent any escape of the contents or any disagreeable smell when removal takes place. The pail is placed underneath the closet seat, which is either made to be movable, or else a door is put in the front for access to the pail. The removal takes place once or twice a week, or oftener in some places, and occasionally—as at Nottingham—the pails take house refuse as well as sewage. When the contents are cleared out, a layer of dry ashes or some deodorant is put at the bottom, and the refuse can be used for agricultural purposes.

Such a plan can only answer on a large scale when the removal and cleaning of pails is in the hands of vigilant authorities, and the expense of the working is a great obstacle. For isolated houses in unsewered areas, and where a sufficient garden is attached, there is no reason why a pail-closet should not answer perfectly, provided someone is responsible for the constant attention necessary.

The closet itself should be outside the house. It cannot be safe—it certainly is not pleasant—to keep excreta inside a dwelling even for twenty-four hours. The roof should be water-tight. There must be good ventilation; this is generally secured by leaving a space above and below the door, so that when closed some light and air may enter.

The floor and all the space beneath the seat should be concreted or flagged; no slops or waste water should ever be thrown into the pail. The more dry the contents are kept the less risk will there be of decomposition, and a covered box of ashes with a hand-scoop should be kept in a pail-closet apartment, so that some of the deodorizing, drying material may be thrown on after use.

Daily removal is the only really safe course, and when a pail has been emptied and thoroughly washed, some ashes, charcoal, dry earth, or sawdust should be well sprinkled over the bottom and sides. It is well to have two pails in use, so that a clean one can be substituted and time left for a soiled one to be aired and purified. The contents of pails can be dug into the garden and make good manure. But should there be a case of enteric or diarrhœa in the house, a separate pail must be kept for the patient with a little strong disinfectant at the bottom. Everything consigned to it must be thoroughly disinfected and burnt, the pail itself being treated with chlorinated lime or strong carbolic (1 in 20), or some other *actual* disinfectant.

Earth-closets.

Earth-closets are virtually only a form of pail-closet, but they are infinitely better because of the deodorizing and purifying influence of the earth. For towns they are impossible, because of the large amount of earth required; but in country houses and villages, in fairs and camps where only temporary arrangements are necessary, nothing could be better. The conditions to be observed for safety are of the utmost consequence.

The rules about the closet itself would be the same as those mentioned above; it must be a dry, well-concreted, airy apartment, as light as possible, and *outside* the house.

The receptacle should be a pail of galvanized iron or some non-porous material which will not absorb moisture or become offensive. Small-sized receptacles are best, so that they are removed frequently. In the case of some very perfect systems earth-closets are only cleared out once in two, or even three, months, but the householder should aim as far as possible at *daily removal*. No chamber slops or waste water of any kind must be thrown into an earth-closet; it is essential to their action that they should be kept as dry as possible, and be well protected from rain.

The earth must be of a suitable kind, such as garden loam, vegetable mould, brick earth, or dry clay. Sand, gravel, and chalk are valueless. The earth should be dried and sifted, and kept for use in some dry place. About 1½ pounds of dried sifted earth should be sprinkled over excreta after each use of the closet. The earth may be stored in a box behind the closet and shot into the pail by some contrivance with a handle; or, where such an arrangement is beyond people's means, it may be kept in a box by the side of the seat, and thrown on with a scoop or pot which has been measured to hold the amount necessary each time. The combination of sewage and earth will make excellent manure for garden purposes.

All these details are of the utmost consequence if an earth-closet is to remain safe. There are many vile insanitary holes called 'earth-closets' by the owners, but which do not answer to one of these requirements, and about which every person belonging to the household is profoundly ignorant.

Middens, or privies.

In many country places the old-fashioned midden or privy is, alas! still to be found. In its worst form it consists of a pit or hole

dug in the ground beneath the wooden seat in which sewage is allowed to accumulate for an unlimited time, from which the soil around is contaminated, wells polluted, and pestilential odours constantly arise to poison the neighbourhood.

It is horrible that such abominations are tolerated by individuals. There is no doubt that the loathsome middens and privies of bygone days were responsible for the constant outbreaks of cholera and various kinds of fevers then so common, and wherever such conditions are found now diarrhœa and other intestinal diseases are liable to be endemic.

If it is ever necessary to manage with a closet of this description we must insist upon the following safeguards: The place itself should be outside the house and entirely separate from it; the Local Government bylaws say not less than 6 feet from a dwelling and 40 or 50 feet from a well. It must be well roofed and provided with light, and with plenty of ventilation openings to the open air as near the top as possible. The whole floor of the privy must be raised several inches above the surrounding ground, and be flagged or paved with tiles, and sloped towards the door. Instead of the old-fashioned pit a receptacle to occupy the space between seat and floor should be provided. This receptacle must be raised several inches above the outside ground, and its bottom and sides made absolutely water-tight by being constructed of non-absorbent material, such as asphalt or concrete. Better still is a movable receptacle which can be taken out for cleaning, so that the disgusting process of digging out the contents is avoided. The seat must be movable to allow of access for cleaning, and slop-water must never be thrown into the midden. The

arrangement is much safer if ashes and cinders are sprinkled over occasionally to keep the contents dry. Daily removal is safest; weekly removal is the very longest period that should be allowed, and the contents must never be carried through a house.

To summarize: of all the various systems for the removal of sewage from a house, water-closets seem best to serve the purpose, provided that ventilation of drain and soil-pipe, disconnection of all wastes, interception from sewers or cesspools, and plenty of water can be insured.

When all or either of these conditions of safety are absent, a pail or earth closet is much better than a water-closet, provided there are sufficient ashes or earth forthcoming, that the closet is outside the house, and there is constant removal.

But, whatever plan may be adopted, much rests with the individual. 'An Englishman's house is his castle,' and the best regulations and initial arrangements made by authorities can be frustrated by carelessness, which no outside inspector can prevent; while it is equally true, and very consoling to remember, that, in spite of the gross indifference and laxity of councils, medical officers of health, and sanitary inspectors, individuals can yet do an immense amount in simple, inexpensive ways to protect themselves.

For district visitors, health visitors, and the many philanthropic workers who visit amongst the poor there are constant anxieties and disappointments about the question of purity indoors and round doors. The poor do not know and do not care; they cannot help themselves if they do care, and it is only in some enlightened places that we find authorities who are sufficiently

earnest and alert to detect and remedy abuses by constant capable inspection. All that can be done is to persistently, and yet tactfully, unveil wrongs and report dangerous conditions to those who *ought to know* while the people themselves, by slow, patient education, may be taught the art of self-protection by the simple precautions of ventilation, cleanliness, and the burning of rubbish.

In regard to this danger of decay vigilance must never be relaxed. In a recent work by one of the most eminent of experts he gives it as his final opinion that 'it is only by the minutest and most constant attention to details we can ever hope to guard ourselves against the dangers that surround us in *any contrivances* for the removal of refuse from the dwelling.'

It may be asked, If the dangers are so serious, if the conditions of safety are of such consequence, why is there not more illness? Considering how common it still is in many places to have bad drains, considering how far more common still it is to find amongst the tens of thousands of houses run up by speculative builders, and 'passed' by so-called 'sanitary inspectors,' the grossest neglect of precautions and safeguards in the water-carriage system, why are there not more deaths?

Death is not the worst result of living in an unhealthy house. Sewer-gas can do worse for a man than kill him. One case that came to the notice of an architect perplexed him much. It was that of a house in which a man had lived for twenty years while all that time sewage had been accumulating beneath the dwelling from an overflowing cesspool and the larder wall had been constantly damp from a leaky soil-pipe. Yet neither the man nor his family had ever been ill. But

it was equally true that they had never been well. The family doctor had never been absent from the house many weeks in succession; there was always something wrong. The children grew up to be undersized and anæmic, lacking in vitality and energy, while no member of the family had been mentally strong and capable.

These are the minor effects of living in badly-drained, unventilated houses, and to posterity these results are of far more terrible import than an occasional outburst of disease. Slowly, silently, but very surely, health is undermined, bodily power weakened, and brain-cells especially deteriorate from poison-laden blood and oxygen starvation.

CHAPTER X

THE STORAGE OF FOOD IN THE DWELLING

Common mistakes about food storage.

In most houses some sort of place is set apart for the storage of food. So far as architects and builders are concerned, these places are often absolutely unsuitable, and it rests with the unfortunate individual to make the best he can of the worst circumstances.

Few people seem to know anything about the importance of the matter. It is often one of the last things thought of in the house. Drains are put right, good water secured, and many modern improvements introduced, but any place is thought good enough for the keeping of food. A few shelves in some dark corner of the basement; a tiny room, with its miniature window opening close to a closet; a cupboard standing in a back area, surrounded by walls and close to gullies and drain-ventilators—these are only mild examples of what are called 'larders' in many town dwellings.

In the country things are almost as bad. The place may be larger, but it is nearly always dark and damp, perhaps underground, near dust-heaps, stables, or cow-byres and pigsties, with often a gully in the floor, for

the convenience of washing, which is in direct communication with the drain.

Food kept in such situations is always liable to become a serious cause of poisoning; it may quickly change from that which is nourishing to that which can cause diarrhœa or even kill; while nothing is more uneconomical than a bad larder, because food will not keep wholesome nearly as long, and there is bound to be much needless extravagance and waste.

Even in some modern dwellings of the artisan type, quite recently finished and with every appearance of attention to sanitary details, we may find a coal-cellar and larder combined, the shelf fixed for the keeping of such articles as milk and butter put just above the place where coal is thrown down and shovelled up when wanted.

When we come to the homes of the distressingly poor, literally no provision exists for the storage of food, and shocking customs prevail. Milk is sometimes kept on a shelf in the closet because it happens to be the only cool spot, or food stands about in living or sleeping rooms, or at the best is shut up in a small, warm, dark cupboard in the wall.

Again, the knowledge of *what ought to be* will help us greatly in the management of our own difficulties and in our opportunities of aiding other people. We must look first at fundamental principles, at the scientific facts which must be remembered when we consider the sort of place in which food should be stored.

The microbes of putrefaction.

The science of bacteriology has taught that there exist in the air all around us multitudes of minute organisms—microbes—which are the cause of those changes in food generally described

as 'turning bad.' These microbes are some of Nature's scavengers; it is their business to attack any dead materials that may happen to be about, and to change them into simple substances that can pass away into air and soil. By these operations they keep the earth's surface clear of débris and rubbish and fit for man's habitation.

Now, food is dead matter, and these very germs, which are so useful to man in some ways, are his terrible foes when it comes to the question of storing food. They are always present in the air of any larder, or dairy, or store-room; it is impossible to prevent their entrance, unless, perhaps, we filtered all the air admitted through cotton-wool! Directly these microbes of putrefaction attack food certain changes begin to take place. The outward signs are alteration in colour, taste, smell, and texture; perhaps spots of mildew and mould appear, and sometimes shininess or phosphorescence.

These appearances indicate that the food is beginning to 'turn,' or 'go bad'; in other words, that the microbes of putrefaction are beginning to do their work. But the internal changes, which constitute the real danger, often take place before the outward signs come to warn us, so it is not always easy to tell whether food is poisonous or not. Soup or jelly, for example, may show very little external alteration, and yet may have changed sufficiently to cause diarrhœa, sickness, and great suffering.

Ptomaines, and ptomaine poisoning.

The nature of poisons varies in the different sorts of foods. They are spoken of as *ptomaines*, by which is meant the poisons manufactured by microbes that attack *dead* bodies, as distinguished from *toxins*, which are the poisons resulting from the work of microbes in *living* bodies.

Some ptomaines are especially dangerous to man; others seem to do little or no harm. For example, we may eat 'high' pheasant without inconvenience, but 'high' pigeon is very dangerous, and may cause acute suffering, or even death. Hare is eaten by many people when in an advanced state of decomposition without harm, while rabbit, unless eaten fresh, is one of the most poisonous of foods.

In fish, especially cod, even in the early stages of putrefaction, poisons have been found as deadly in their nature as the most venomous snake; others of a very dangerous character have been found in decaying sausages; and ptomaines which cause severe suffering and fatal results have been discovered in bad ice-cream.

At a sale some years ago seventy-two persons fell ill, and four died, after partaking of some sandwiches in which the meat was bad. On one occasion, at a convent in Ireland, several people died from eating custard made with eggs, one of which was confessed by the cook to have been 'claret-coloured, with a bad smell.' Occasionally a newspaper paragraph is headed 'Ptomaine poisoning from sardines,' or 'from potted meat,' or 'tinned tomatoes,' or 'rabbit pie.' In none of these cases could the food in itself have done harm if fresh and good; it was the ptomaines manufactured by the germs of putrefaction that were the cause of injury.

More will be said on tinned foods later, but it may be useful here to mention that amongst the foods in common use which are most dangerous when not quite fresh, and most likely to cause ptomaine poisoning, are fish, rabbit, pigeon, tinned foods, soups and jellies of all kinds, including aspic for garnishing, and pork.

Obviously ptomaine poisoning is not always due to

bad storage. The pork used for pie or sausages, the fruit or fish consigned to the tin, the rabbit or pigeon when brought to the house, may have already become poisonous. In such a case even thorough cooking may not protect us. The heat of cooking operations will kill any microbes present, but it may not affect the chemical poisons—the ptomaines—manufactured by the germs. Hence the extreme importance of choosing food carefully, of refusing 'blown' tins, or soft, flabby fish, or any article which has an unnatural smell, texture, or appearance.

But we are considering the question of the larder, and the fact must be borne in mind that, however good food may be in the first instance, if it is kept in unhealthy, unsuitable places it may quickly become a cause of serious and fatal injury.

What can the housekeeper do? If food is suitable material, and the microbes are always present, what can be done to prevent their attacks? The answer is, We must arrange our plans to make their work difficult, and to hinder its progress.

Microbes are very susceptible to surrounding influences. Damp, darkness, still air, warmth, exhalations of effluvia from unwholesome surroundings, all *help* the microbes of putrefaction, while dryness, cold, light, wind, and a pure environment, hinder their activities and delay their operations.

Hence the following rules should be observed as far as our circumstances and means will possibly allow:

A sanitary larder.

A larder should be cool. Cold hinders putrefaction, and if sufficiently extreme will actually prevent it. The American method of preserving meat is a proof of this, and milk cannot be

attacked by the organisms which cause it to 'turn' when the temperature is below 50° F.

A north aspect is best, and if we are unfortunate enough to have a larder facing south or west through the builder's ignorance, various devices must be resorted to in warm weather to keep down the temperature.

A dark green blind to keep out the direct rays of the sun, but fixed loosely so that plenty of air can enter, a canvas blind frequently wetted, or an outside blind which can be sprayed, are all little inexpensive methods of cooling.

Blocks of ice, where the luxury can be afforded, should be put in basins near butter and milk; but plenty of ventilation, so that there are constant air movements, is the best means of all for counteracting the drawbacks of a hot larder.

The place where food is kept must be dry. Germs cannot get on without some moisture. Some bacteria actually die after a short time in perfectly dry surroundings. Hence everything must be done to avoid or counteract damp. The larder floor should be of concrete or evenly laid tiles or flags, and it should have as much outside wall as possible, so that it is externally dried by the influence of the wind. Special care should be taken to see, if a rain-water pipe passes near, that its joints are water-tight, that there is no chance of rain overflowing or dripping upon the larder roof or walls from badly constructed or blocked gutters or pipe heads. When the floor and shelves are cleaned it must be done with as little water as possible, and on days of actual washing food must be cleared out, doors and windows put wide open, and a good drying day chosen.

A larder should be well ventilated. The microbes of

decay flourish in rest and still, stagnant air; a wind or draught is always inimical to their life processes. Food keeps as long and as well again if there is a good current of air round. Not only should there be a good-sized window, a large part of which is always kept open, but there should either be a second window, or some ventilating brick, grating or shaft, to allow of ventilation *apart from the door*.

It is very important to keep the larder window always open: a piece of perforated zinc fastened across the opening will protect from cats and other marauders, but this must be kept clean, or the air will not pass through freely.

The place where food is stored should be light. In olden days the idea prevailed that the darker the dairy, storeroom, or larder, the better food would keep, and all light was carefully excluded. But recent discoveries have taught us that sunlight is exceedingly destructive to microbe life, and that only fungi and the very growths we want to exclude from our larders love the dark. Light is a purifier, and every nook and corner should be light enough to insure another condition of sanitary food storage—viz., absolute cleanliness. Where places are dark, cobwebs, dirt, food-scraps that ought to be burnt, and any rubbish, are likely to accumulate unnoticed.

Everything about a larder must be sweet and clean. The ceilings must often be whitewashed, the walls—if the luxury of tiles or some glazed paint cannot be managed —should be distempered or limewashed at frequent intervals.

It is a help to coolness and cleanliness if the shelves are of slate or stoneware instead of wood; and if wooden shelves are unavoidable, they may be advantageously

covered with pieces of oilcloth or camptulicon, or some material which will not absorb anything that may be spilt, and which can be taken off for cleaning and dried in the open air.

Purity of surroundings is of great consequence. There should be no gully or trap of any kind in a larder floor; no drain-pipe should pass through the walls; it should not be next to a water or earth closet; and no ashpit or rubbish-box should be close enough for effluvia or dust therefrom to have a chance of reaching the food.

Food should never be kept in a place where lumber or rubbish is stored. People put all sorts of things that are not wanted in larders; and such articles as coal-scuttles, old boxes and baskets, brooms, or empty luggage, must only harbour dust, and make the surroundings stuffy and unwholesome. Nothing but the breadpan and filter should be kept in a larder besides utensils for holding the food.

One more rule, and that the most important of any, is to *keep all food covered with pieces of muslin.* Dust is a great germ-carrier, and should never be allowed to reach food. Even when things are laid on the table for use, muslin should be thrown over to protect from dust and flies. This is a very simple and inexpensive precaution, and within the reach of everybody.

Improvised larders.

Many little devices can be resorted to for keeping food where there are no larders, or where the places provided are absolutely unsuitable. Tubs, to be obtained of the grocer for a mere trifle, can have shelves fastened in at the sides, and a movable piece of perforated zinc over the top as a lid, and these can be stood in the area or courtyard, or whatever small outside place there may be, as far from any impure surroundings as possible. An old tea-chest, with

some perforated zinc let in at the sides for cross-ventilation, and fitted with a shelf, and protected on the top by a sloping piece of corrugated iron, can be hung up on the wall, and food with the muslin covers will keep far better in this crude out-of-door shelter than in many elaborate larders.

The one great thing to impress on people is that food —especially milk, butter, soup, and jelly-like materials— should always be kept in as much open air as possible, and should *always* be covered from dust and flies.

Milk.

Milk is a particular anxiety because of its strangely absorbent properties, and because of the many different ways in which it may become a channel of disease.

There is the possibility that it may at the beginning contain the microbes of specific diseases. If the cow is tuberculous—and great numbers are—its milk becomes at once a possible means for conveying this terrible illness to human beings, especially when they are at the young and susceptible period of life.

If contaminated water is used even just for the washing of the cans, the milk may contain the germs of typhoid fever, and bring to us, perhaps, a wide-spread epidemic.

If anyone suffering, or even convalescing, from scarlet fever, diphtheria, or measles should come in contact with the milk or dairy utensils, these diseases may be conveyed to those who drink the milk. In 1882, Mr. Ernest Hart collected information which showed that up to that time no less than seventy-one epidemics could be definitely traced to infected milk since inquiries on the subject had commenced, fifty-one of typhoid, fourteen of scarlet fever, and seven of diphtheria. In 1901 an outbreak of scarlet fever in Bethnal Green was traced entirely to the milk

brought to London from one farm in Shropshire, where one person connected with the dairy had been suffering from the disease.

But these dangers can be entirely avoided. Every risk of milk becoming a source of tuberculosis, scarlet fever, diphtheria, or any such illness can be completely prevented by the simple expedient of *boiling the milk.*

Sir James Crichton Browne, in an address to working people in the North of England, said: 'I confess it is to me astonishing that this precaution, which is within the reach of everybody, is so little recognised in this country. Perhaps the day will come when it will be considered as unpleasant and against the stomach of the people to partake of raw milk as it is to partake of raw meat.'

Even if milk is boiled, its storage is a matter of grave consequence. It absorbs impurities like a sponge absorbs water, and if kept in close, vitiated air, near bad drains or closets, or the effluvia from rubbish-heaps, or in the same place with any putrefying food, it may quickly become tainted and poisonous.

Milk should be given its own place in a larder near the open window and away from all strongly-smelling substances; it must be kept in perfectly clean utensils, which are well scalded, rinsed, and wiped after using, and large open-mouthed jugs or basins are far better than the narrow-necked jugs into which it is impossible to get the hand. And, most important of all, milk should always be covered and protected from dust by a piece of clean muslin. Where there is no proper place for storing food, milk is better kept outside on the window-sill rather than inside stuffy living or sleeping rooms. All that need be done is to cover from blacks and dust, and to notice that it is not close to any drain-pipe.

Tinned foods.

Tinned foods, as already remarked, need special care, as when once opened they are quickly affected by the germs of decay. An enormous quantity of these kinds of provisions are used in the present day; 581,000 pounds of canned goods are said to be eaten daily in England.

There is no objection whatever to this method of preserving food, as long as the materials are good in the first instance. But a few rules are of such consequence that, though they do not all belong to the subject of this chapter, it may be useful to mention them for the guidance of the housekeeper:

Never buy tins that have no name or stamp upon them.

Always notice the shape of a tin. The ends should be concave, or slightly curved *inwards*. If there is any bulging it is probably a 'blown' tin, and the contents might be highly poisonous. It is illegal to sell blown tins, and heavy fines are inflicted on the vendors.

Look out for any marks of double sealing, as if the can had been opened, or perhaps only pricked and then sealed up again. There should only be one spot where a tin is fastened up.

When opened, tinned food should have a perfectly natural appearance and smell; there should be no mildew or discoloration.

Always turn the food out of a tin when it is opened into a glass or china vessel. Nothing should ever be kept in the tin after opening.

Keep food turned out of tins in as cool and dry a place as possible and covered over with muslin, and do not keep it about long, as it quickly goes bad, especially in warm, damp weather and insanitary larders.

If tins have to be kept in the house for awhile before opening they should be stored in a cool place and away from the sun's light. This is especially true of tinned fruits, and they should not be kept in shop-windows or where they can get heated.

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